

Operating instructions

LIMES



Hardness control device for automated monitoring
of total hardness in the process water

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Foreword

Thank you for purchasing a LIMES analyser for online monitoring of water hardness.

- The LIMES analyser for monitoring water quality is part of the water treatment plant.
- This manual is intended for the manufacturer and the operator of such a unit. It contains instructions for the installation and operation of the unit.
- Please read this manual carefully before operating the unit.
- We recommend that you always keep the manual close at hand during operation.
- Operate the unit only in accordance with the instructions in this manual.
- Under no circumstances will we be liable for any damage caused by operating errors or failure to follow the instructions in this manual.
- Some details and instructions in this manual may differ from your actual purchased unit. We reserve the right to make technical changes without prior notice.

On our website www.rls-wacon.de you will always find the latest version of our documentation.



The LIMES analyser automatically detects hardness breakthroughs in a water treatment system and issues a message when the limit value is exceeded. This message can be used, for example, to trigger regeneration of the water softener.



The LIMES analyser is not a device that prevents hardness breakthroughs.

Conversion for the units of water hardness

		°dH	°e	°fH	ppm	mval/l	mmol/l
German degrees	1 °dH =	1	1,253	1,78	17,8	0,357	0,1783
English degrees	1 °e =	0,798	1	1,43	14,3	0,285	0,142
French degrees	1 °fH =	0,56	0,702	1	10	0,2	0,1
ppm CaCO ₃ (USA)	1 ppm =	0,056	0,07	0,1	1	0,02	0,01
mval/l Alkaline earth ions	1 mval/l =	2,8	3,51	5	50	1	0,5
mmol/l Alkaline earth ions	1 mmol/l =	5,6	7,02	10	100	2	1

The unit 1 ppm is used here contrary to the actual literal sense in the sense of 1 mg/l CaCO₃.

Brief description

With the LIMES analyser, RLS Wacon offers a compact and very easy-to-use analyser for the automatic online monitoring of water treatment plants.

The measuring device works on the principle of "limit value monitoring with colour change" and provides all important functionalities for reliable field use.

The LIMES analyser automatically carries out water analyses at regular intervals to determine the total hardness.

Based on the reagent type used, a limit value is specified by the user. There are 4 reagents available for monitoring the total hardness.

If the limit value is exceeded, the unit outputs a message on a potential-free relay output. This message can be further processed by a softening control. In this way, functions such as automatic regeneration triggering can be realised.

The LIMES analyser is characterised by low maintenance costs. Up to 10,000 analyses can be carried out with a 750 ml reagent bottle. The input contact of the device can additionally be used to connect a flow monitor to the device. In this way, the LIMES interrupts the analysis interval during downtimes of the water softener and automatically resumes the analysis when the unit is put back into operation.

To prevent disturbances due to the counter ion effect, a first value suppression is available. If the limit value is exceeded, this first carries out another control measurement before a hard water message is issued.

You will find in-depth and much more information about your new LIMES analyser in this manual.

Scope of delivery

The scope of delivery for a new unit includes the following items:

- LIMES analyser with 1.75m connection cables
- Operating instructions

Optional accessories:

- Front cover for analyser (transparent)
- Junction box (for electrical installation)
- LIMES connection set (for water supply)
- Stopcock



Further information on accessories can be found from page 65.

General

These operating instructions describe the installation and operation of the LIMES on-line analyser. Installation and commissioning may only be carried out by an authorised specialist.

The unit may only be operated under the conditions described in these operating instructions. The unit may only be used for the specified purpose. When installing and operating the analyser, all locally applicable regulations (such as EN, DIN, VDE, UVV) must be observed.

The analyser is used for the automatic determination of the total water hardness in the process water. Proper operation can only be guaranteed if the reagents and spare parts recommended by us are used.

Changes to the electrical wiring and programming may only be carried out by a designated specialist.

The water connection lines to the unit should be kept as short as possible and should not be laid together with mains lines or in their immediate vicinity. In the vicinity of strong electromagnetic radiators, interference with the analysis may occur; in this case, separate interference suppression measures must be taken, in particular the EMC guidelines must be observed.

It is recommended to always have access to the analyser when familiarising oneself with the help of these operating instructions in order to be able to understand the explained correlations and functions immediately. Since certain areas build on each other, it makes sense to work through the chapters in the given order.

If you have any questions about the use of the analyser, you will receive support from our partners or from us. You can reach us by telephone during normal business hours or by e-mail. The contact details of our technicians and our partners can be found on our website.

General

Quick overview: LIMESBase and LIMESPlus

	LIMESBase	LIMESPlus
Parameters:		
Limit value reagents Total hardness	0.1 / 0.5 / 3.0 / 7.0 °dH	
Bottle size reagent	750 ml	750 ml
Shelf-life reagent in months	24	24
Contacts:		
Input contact (INPUT, start or stop analysis interval)	✗	✓
Relay output 1 (Boundary value alarm)	✓	✓
Relay output 2 (Unit fault or reagent message BoB)	✓	✓
Functions:		
Adjustable flushing time	✗ Fixed 50 sec.	✓
First value suppression	✓	✓
Adjustable analysis interval	✗	✓
Available analysis intervals	10 min	5 / 10 / 20 / 30 min
Diagnosis mode	✗	✓
Technical data:		
IP protection class without front cover	IP43	IP43
IP protection class with optional front cover	IP54	IP54
Protection class	SKII	SKII

✓ - Available

✗ - Not available

For more information, see page 21 and 68.

General

Safety instructions and symbols used

In this operating manual you will find various safety instructions that point out possible risks when handling the analyser. This concerns in detail dangers for

- People,
- this product or associated equipment and installations,
- the working environment.

Various symbols in these operating instructions indicate special dangers to prevent personal injury and damage to the appliance. Please read the entire text completely before starting work.



This symbol draws your attention to useful tips that contribute to a better understanding of the unit.



This symbol is a general warning that indicates circumstances that must be observed.



Pressure

This symbol is a warning that you must expect pipes under pressure.



Irritant

This symbol indicates the danger of harmful as well as irritating chemicals. Avoid direct skin contact.



Voltage

This symbol indicates the danger of electric current and the danger to persons and electronic components and assemblies.

Transport



Immediately after receipt, check that the unit is complete and has no transport damage. The analyser is delivered in a transport-safe condition. Nevertheless, damage may occur during transport. Immediately inform the delivery person of any transport damage.



Protect the analyser from possible damage during transport. Remove any liquids still in it beforehand. Remove the reagent bottle and close it to prevent the reagent from leaking.

Storage



Store the analyser in a dry place at temperatures between 0 - 45 °C and out of direct sunlight.

Disposal notes

The appliance must not be disposed of with residual waste. Take the appliance to a collection point.

Alternatively, you can return the analyser to your dealer or to us for disposal.

Performance features

Fully automatic

The unit detects hardness breakthroughs fully automatically when the limit value of the reagent used is exceeded.
The analysis process is more reliable than manual methods and more sustainable than other measurement methods. Compared to swelling resin sensors or electrodes, no regeneration, calibration or replacement of the sensor element is necessary.

Intelligent and self-sufficient

The device does not need to be calibrated. Due to the integrated measurement technology and a two-stage analysis procedure with zero-point measurement, external measurement influences due to contamination of the measurement chamber, turbidity of the sample and extraneous light influences is detected and eliminated during the evaluation of the analysis.
The integrated full colour sensor is one of the central components for the self-sufficient operation of the unit and does not need to be maintained or replaced.

Selectable interval time (LIMESPlus)

The interval time between two measurements can be set in 4 steps: Interval times of 5 / 10 / 20 / 30 minutes can be selected. The analysis can also be started via an external switch or paused when the system is at a standstill.

Self-calibrating

Hardness breakthroughs are reliably detected by using LHV limit reagents. Our reagents are calibrated to a fixed limit value in production. You choose the reagent to suit your requirements. No further configuration or calibration is necessary.

First value suppression

After a bad measurement, a reference measurement is taken every 4 minutes to evaluate the result. This prevents false alarms due to the counter ion effect after a system shutdown.

Extensive alarm functions

If the limit value is exceeded, an alarm is issued by switching a potential-free relay. This alarm output can be connected to a control room for signalling or used to activate a horn, close a valve or control a programme for regeneration of a softening system.

Performance features

Diagnostic programme (LIMESPlus)

If technical problems occur at the unit, a fault message is output by switching a potential-free relay. The detailed diagnostic programme in *LIMESPlus* enables step-by-step testing of all unit functions. In this way, the unit is thoroughly checked, and the cause of the error message is clearly identified.

Minimal maintenance effort

Depending on the set measuring interval or the frequency of the measurements, the measuring chamber must be cleaned. The hose pump cassette and sealing rings typically only need to be replaced every 24 months.

Efficient reagent consumption

The reagent bottle is easy to replace. A freshly inserted 750 ml bottle allows up to 10,000 analyses.

Digital input contact (INPUT, start or stop analysis interval) only with LIMESPlus

The potential-free switch of a flow monitor, a timer or another status switch can be connected to this input, for example. When the contact is open, no analyses are carried out in the programmed interval.

Alternatively, this input can be used as a start input for analyses.

Two potential-free relay outputs

The potential-free relay outputs can be used to signal a limit value alarm, a device fault or a reagent message BoB, e.g., to a control room. Alternatively, signalling devices or service valves can be switched.

Specifications

General specifications

Parameter	Value / Range	
Power supply	100 - 240 VAC (50/60 Hz)	
Protection class	II	
Power consumption	15 VA (in operation)	
Load capacity of the relay outputs	2.5 A per relay	
IP protection class	without front cover IP43	with optional front cover IP54
Storage temperature	0 °C - 45 °C	
Ambient temperature	10 °C - 45 °C	
Measured water temperature	5 °C - 40 °C	
Humidity	20 - 90 % RF (without ice or condensation)	
Inlet water pressure	min: 0.5 bar - max: 5 bar / recommended 1 - 2 bar	
Inlet water in general	clear, colourless, free of solids, without gas bubbles	
Water quality requirements for the measurement of water hardness	pH:	4 - 10
	Iron:	< 3 ppm
	Copper:	< 0.2 ppm
	Aluminium:	< 0.1 ppm
	Manganese:	< 0.2 ppm
	Acid capacity:	KS 4.3 < 5 mmol/l

Note on oxidising agents:

Oxidising agents such as calcium hypochlorite, chlorine, chlorine dioxide, sodium hypochlorite or ozone above the limits permitted in "TrinkwV 2012" attack the dye contained in the reagent and interfere with the measurement. This means that an exact determination of the water hardness is no longer guaranteed. An activated carbon filter connected upstream of the analyser can remove these oxidants from the sample water and thus enable the correct determination of the water hardness.

The capacity of an activated carbon filter is consumed during operation. Therefore, the activated carbon filter must be replaced at regular intervals. The effectiveness of the activated carbon filter can be checked with the help of Caldur® test sets.

Signal input and outputs

Parameter	Value / Range
Relay outputs	2 Relay 2.5 A / 250 VAC 2.5 A / 100 VDC as potential-free outputs NC/NO The relays provide the following functions: <ul style="list-style-type: none"> • Limit value alarm (relay output 1) • Device fault or reagent message BoB (relay output 2)
Input contact (INPUT, start or stop analysis interval) only with LIMESPlus	Galvanically isolated input contact for connection of a potential-free contact <ul style="list-style-type: none"> • Start analyses (external analysis interval) • Flow monitor (analysis interval interruption during system standstill)

Specifications


Technical data

Parameter	Value / Range
Installation	Wall mounting in closed rooms
Dimensions	without lid: 250 x 330 x 60 mm (W x H x D)
	with lid: 250 x 330 x 90 mm (W x H x D)
Weight	without lid: approx. 1.8 kg
	with lid: approx. 2.1 kg
Inlet/outlet connection	Plastic hose with 1/4-inch outer diameter

Analysis properties

Parameter	Value / Range										
Measuring principle	Colorimetric method										
The limit value alarm is defined by the reagent used	<ul style="list-style-type: none"> <u>Total hardness limit reagents:</u> <table> <tr> <th>Reagent</th><th>Limit value</th></tr> <tr> <td>LHV - 0.1</td><td>0.1 °dH</td></tr> <tr> <td>LHV - 0.5</td><td>0.5 °dH</td></tr> <tr> <td>LHV - 3</td><td>3 °dH</td></tr> <tr> <td>LHV -</td><td>77 °dH</td></tr> </table> <p><i>For more information, see page 69</i></p>	Reagent	Limit value	LHV - 0.1	0.1 °dH	LHV - 0.5	0.5 °dH	LHV - 3	3 °dH	LHV -	77 °dH
Reagent	Limit value										
LHV - 0.1	0.1 °dH										
LHV - 0.5	0.5 °dH										
LHV - 3	3 °dH										
LHV -	77 °dH										
Reagent consumption	<ul style="list-style-type: none"> < 0.10 ml / analysis Up to 10,000 analyses per 750 ml reagent bottle 										
Accuracy	Measurement accuracy: <ul style="list-style-type: none"> ± 10 % of the limit value of the respective reagent used 										
Durability of the reagents	24 months from date of manufacture										
Water consumption	<ul style="list-style-type: none"> Approx. 2 L / analysis The water consumption varies depending on the inlet pressure and the set flushing time 										

Maintenance intervals

Interval	Maintenance work
every 6 months	Cleaning the measuring chamber
	In case of high ambient and water temperatures or water with a high organic load, the cleaning intervals may have to be shortened.
After 24 months of operation	Installation Maintenance kit: Changing the hose pump cassette and the seals

Further information can be found on pages 52 and 67

Installation

Installation requirements



The LIMES analyser may only be used for determining the total hardness in water.



Changes to the electrical wiring and parameterisation may only be carried out by an authorised and experienced specialist.

Voltage

The installation to be monitored must fulfil the following conditions:

- The maximum permissible load capacity of the relay outputs and the total power of the system must not be exceeded by the connected load.
- All inductive loads (valves, motors, contactors, transformers) in the system must be equipped with suitable overvoltage protection (e.g., RC element, varistor, diode, etc.).
- If there are external devices with a high mains interference level in the vicinity of the control unit, these must be reduced with suitable measures, or appropriate external interference suppression measures (mains filters) must be taken at the supply voltage input of the control unit.

Installation

Wall mounting LIMES

The LIMES analyser can be mounted directly. An additional front cover is optionally available for protection against dirt and dust.

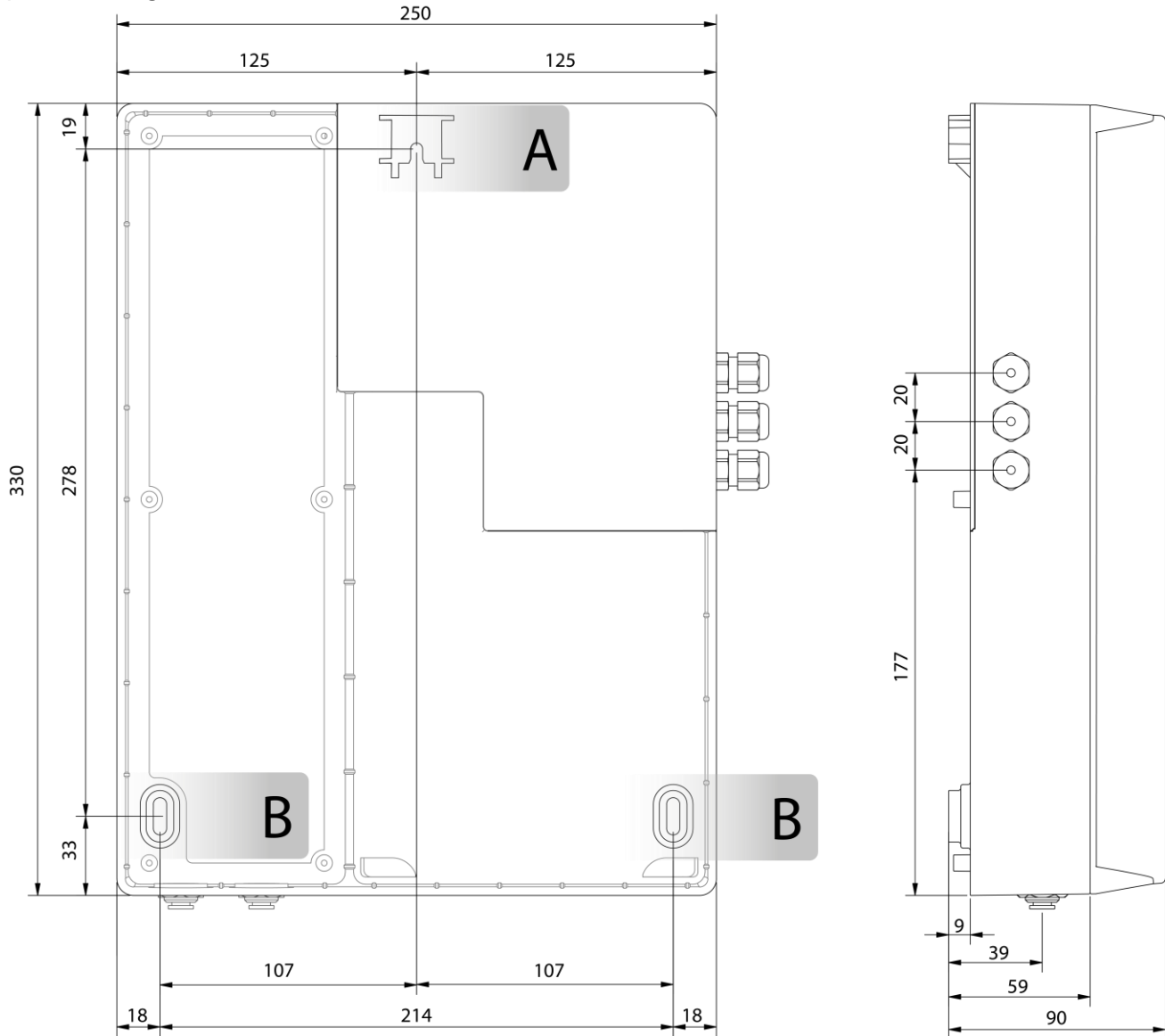


Illustration 1: LIMES - rear and side view (dimensions are in mm)

The unit is attached to a wall or suitable supporting structure using 3 screws (max. Ø 5 mm).

1. Select a suitable mounting location
2. First pre-mount a screw (A) on the wall.
3. Suspend the analyser, align
4. Finally, fix to the wall from the front with two screws (B).



Voltage

Do not install the analyser under dripping pipes.

Safety reliably produced.

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Installation

Wall-mounted junction box (optional)

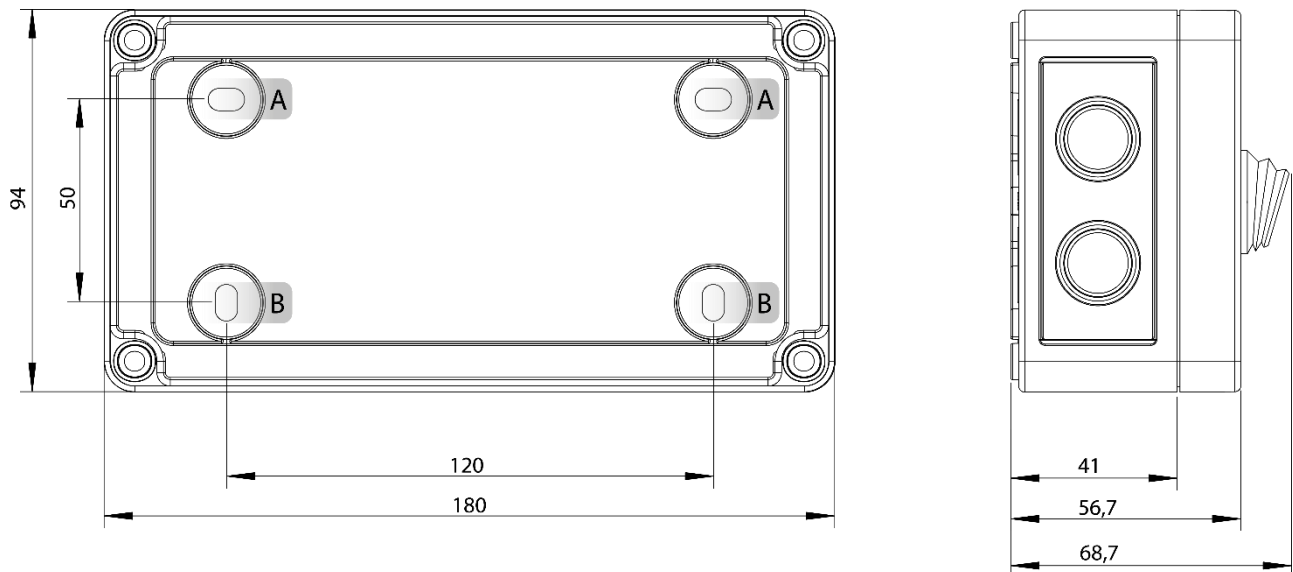


Illustration 2: LIMES junction box - front and side view (dimensions are in mm)

The junction box is attached to a wall or suitable supporting structure using 4 screws (max. Ø 6 mm).

1. Select a suitable mounting location
2. First pre-mount on the wall with two screws (A).
3. Align junction box
4. Finally, fix it to the wall with two screws (B).



Voltage

Do not install the junction box under dripping pipes.

Installation

Establish supply line to the sample water and to the canal

i The connections for inlet and outlet are designed for flexible plastic hose with 1/4-inch outer diameter.

A manual shut-off valve must be provided between the preparation unit and the analyser. A suitable valve can be found in the product catalogue or in the spare parts list. When connecting to a drinking water pipe, the installation must take EN 1717 into account. The drain must lead into an open channel via a short connection. The drainpipe must remain depressurised.



Make sure that the inlet and outlet are not interchanged. The inlet is located on the left side of the inlet filter.

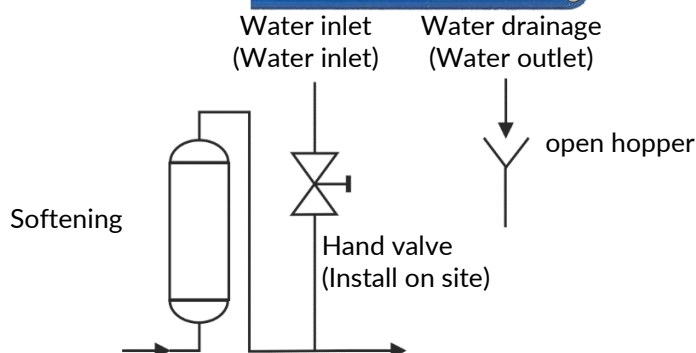


Illustration 3: Connecting the water inlet and outlet



Pressure

The inlet pressure of the water sample must be between 0.5 and 5.0 bar.



The recommended inlet pressure of the water sample should be between 1 and 2 bar.



The hose length of the water drain must not be longer than 2 m and must lead away vertically downwards. The system must be able to relax freely against the atmospheric pressure (no counterpressure). The water drain is pressureless into an open funnel or drain.

Device overview



**Illustration 4: LIMES analyzer with indicator bottle installed (I.),
schematic representation of the measuring chamber (r.)**

Position	Description	
A	Control	
B	LED display	
C	Operating buttons	
D	Cable gland	
E	Dosing pump (peristaltic pump cassette)	
F	Measuring chamber	
G	Filter	
H	Pressure regulator	
I	Reagent bottle 750 ml	
J	Solenoid valve	
K	Water inlet / sample water	Push-in connection for plastic hoses with 1/4-inch outer diameter
L	Water drainage	
M	Measuring chamber drain	
N	Measuring chamber inlet	
<i>In the housing / not visible</i>		
O	Magnetic stirrer	
P	Stirrer blade	
Q	Injector	
R	Optical measuring path	
S	Actuator board (LED)	
T	RGB sensor	

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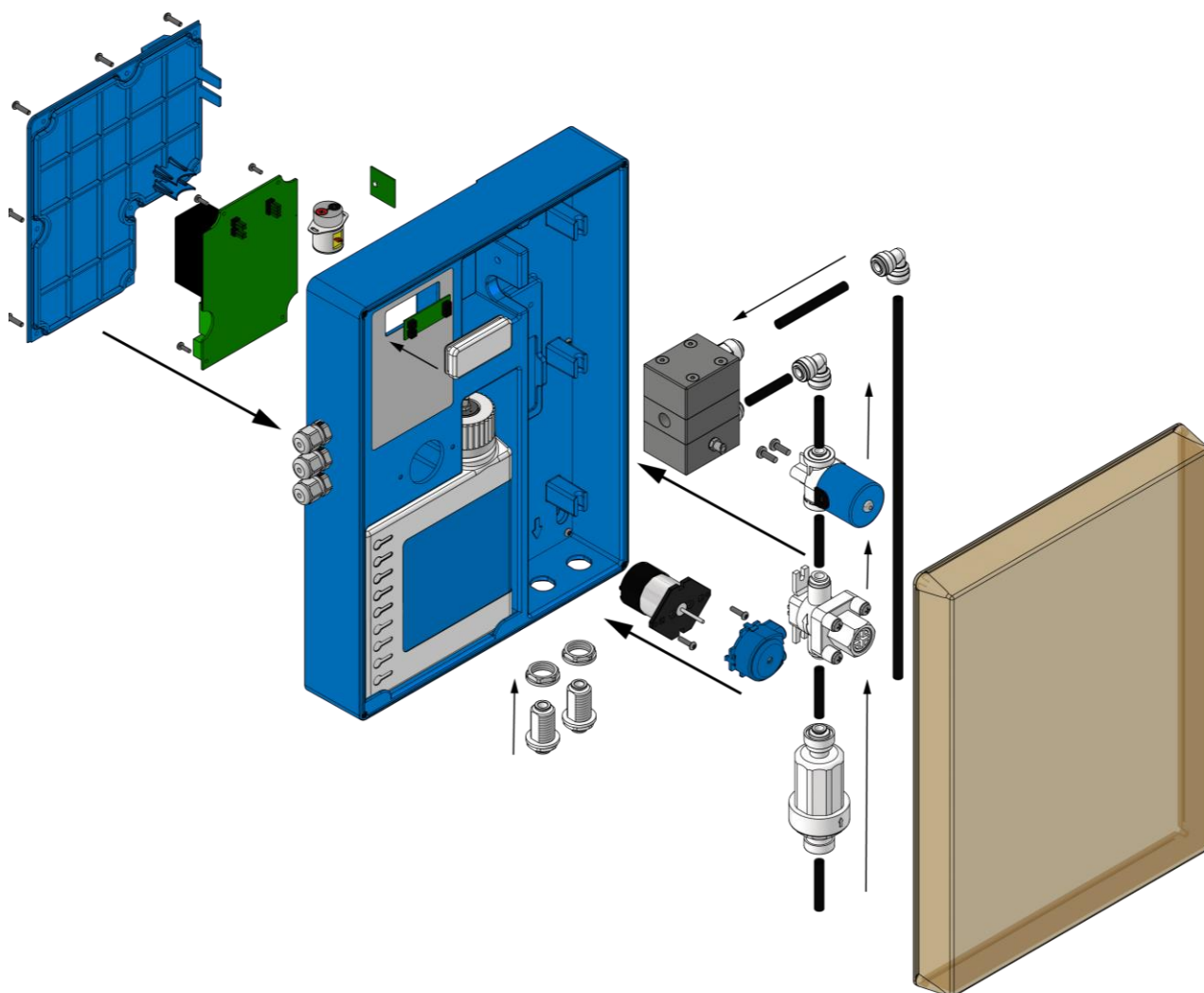


Illustration 5: LIMES exploded view - assembling the components



Observe the correct placement and flow direction when replacing components or performing other work on the analyser.

Device overview

Displays and front panel

On the front of the LIMES analyser there are 4 LEDs to indicate the operating status and 4 keys to operate the unit.

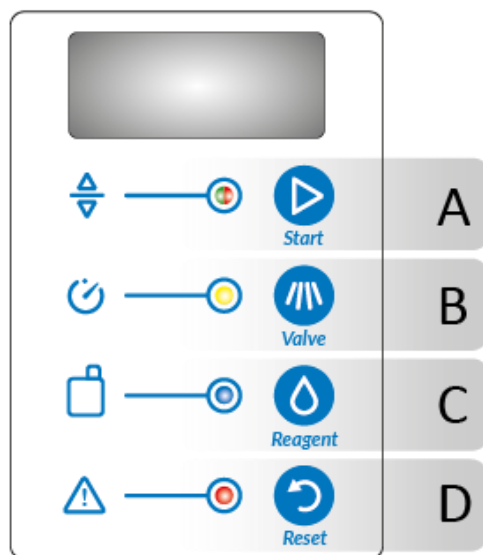


Illustration 6: LIMES - Unit overview / front foil

The LED display shows the operating status:

LED	Colour	Information
A	Green (two-colour LED)	Limit value undershot
A	Red (two-colour LED)	Limit value exceeded
B	Yellow	Analysis active
B	Yellow flashing	Input contact open, e.g., by flow monitor
C	Blue	Provide reagent
C	Flashing blue	BoB message
D	Red	Device fault



Further information can be found from page 35 and 47.

Device overview

Overview of the configuration elements

The LIMESPlus analyser has configuration elements located on the plug-in board under the rubber plug:

- 1 Rotary switch for setting the flushing time (A)
- 4 Programme switch for configuring the operating requirements (B)

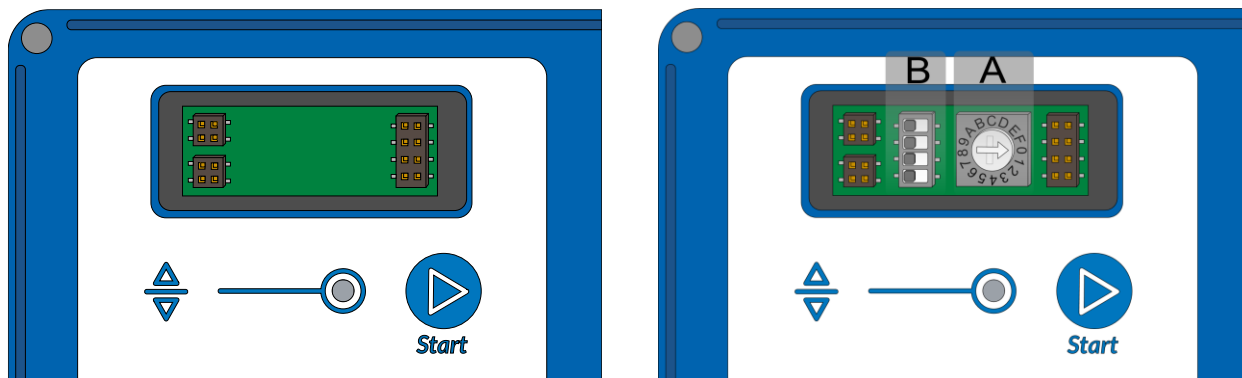


Illustration 7: Plug-on board, LIMESBase (l.) and LIMESPlus (r.)

Position	Information
A	Rotary switch for setting the rinsing time
B	Programme switch for configuring the operating requirements



Observe the plug-in direction of the plug-on board when upgrading from LIMESBase to LIMESPlus.

Upgrade Kit from LIMESBase to LIMESPlus

In order to upgrade a LIMESBase, you need an upgrade kit containing the required components (LIMESPlus plug-on board, board extractor, LIMESPlus rubber cap). By inserting the LIMESPlus plug-on board, the LIMESPlus functions are enabled.

For more information, see page 8 and 68.

Electrical installation

Overview of the electrical connections (main board):

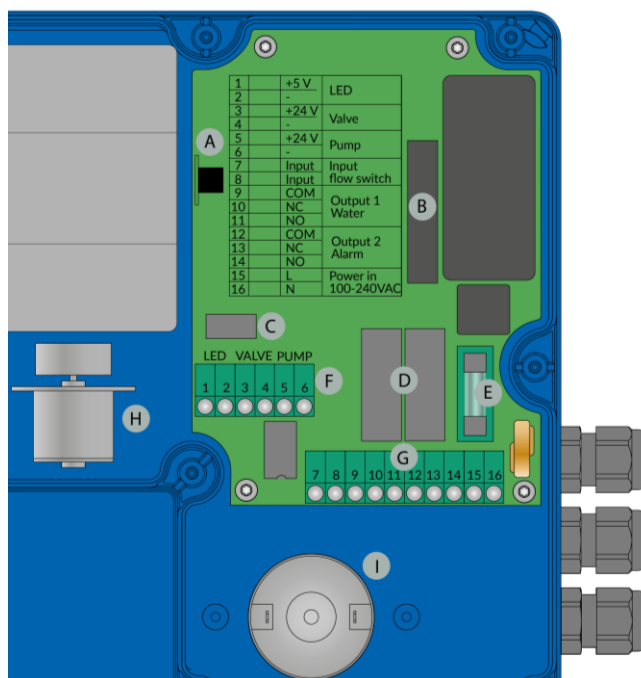


Illustration 8: Electrical connections - main board

Position	Description
A	RGB sensor
B	Controller
C	Connection magnetic stirrer (H)
D	2x relay
E	Fine-wire fuse (5 x 20 mm) 400 mA (inert)
F	Connections: - Actuator board (LED) 1 (Red): + 5V 2 (Black): - - Solenoid valve (Valve) 3 (Red): + 24V 4 (White): - - Dosing pump (Pump) (I) 5 (Red): + 24V 6 (Black): -
G	Connections: - input contact 7 (Black 1): 8 (Black 2): (Input flow switch) Start or stop - Relay output 1 9 (White): COM 10 (Brown): NC 11 (Green): NO (Output 1 Water) Limit value alarm - Relay output 2 12 COM 13 (Grey): NC 14 (Pink): NO (Output 2 Alarm) (Yellow): Device fault / reagent message BoB - Power supply 15 L 16 (Blue): N (Power in) (Brown):
H	Magnetic stirrer (connection C)
I	Dosing pump (connection 5 and 6)

Electrical installation

When working on the electrical connections, the following instructions must be observed:

- Screwable and plug-in terminal blocks are suitable for accommodating rigid single-core conductors up to 2.5 mm². Fine-core conductors up to 1.5 mm² can be connected with wire end ferrules, with plastic collars or up to 2.5 mm² without plastic collars. To loosen a terminal, use a slotted screwdriver SL with a maximum blade width of 3 mm.
- The relevant VDE regulations must be observed during all installation work.



Voltage

Before opening the housing, disconnect the unit from the power supply and secure it against unintentional reconnection.

The installation of a suitable electrical disconnecting device is the responsibility of the system operator.



Voltage

The maximum connected load of all loads must not exceed 250 VAC / 2.5 A or 100 VDC / 2.5 A. Provide suitable interference suppression for inductive loads.



Voltage

Work on the electrical equipment of the system/machine may only be carried out by a trained electrician!

Electrical installation

Overview of the electrical connections (cables):

In the standard scope of delivery (without junction box), you will receive the LIMES analyser with 3 cables leading out. The length of the cables is 1.75 m, they are stripped, and the individual wires are fitted with wire end ferrules.



Observe the function and colour coding of the wires during electrical installation.

Function	Name	Colour	Illustration
Power supply (Power in)	L	Brown	
	N	Blue	
Relay output 1 (Output 1 Water) Limit value alarm	COM	White	
	NC	Brown	
	NO	Green	
Relay output 2 (Output 2 Alarm) Device malfunction/ Reagent message BoB	COM	Yellow	
	NC	Grey	
	NO	Pink	
Input contact (Input flow switch) Start or stop	1	Black 1	
	2	Black 2	



Voltage

Before opening the housing, disconnect the unit from the power supply and secure it against unintentional reconnection.

The installation of a suitable electrical disconnecting device is the responsibility of the system operator.



Voltage

The maximum connected load of all loads must not exceed 250 VAC / 2.5 A or 100 VDC / 2.5 A. Provide suitable interference suppression for inductive loads.



Voltage

Work on the electrical equipment of the system/machine may only be carried out by a trained electrician!

Electrical installation

Overview of the electrical connections (junction box):

The optional junction box for the LIMES analyser ensures easy access to the existing electrical connections and has an on/off switch.

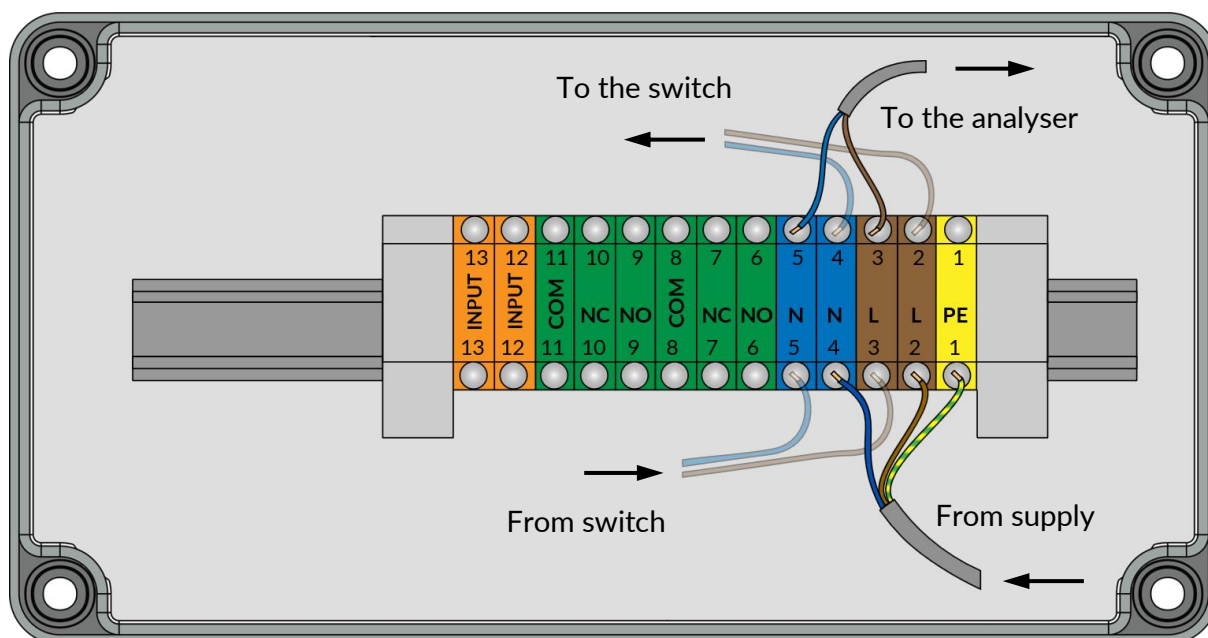


Illustration 9: Electrical connections - junction box

Position	Designation	Function
1	PE	
2	L power in	Connection for supply voltage, with wiring for On/off switch on the junction box
3	L power out	Switched supply voltage for the LIMES analyser
4	N power in	Connection for supply voltage, with wiring for On/off switch on the junction box
5	N power out	Switched supply voltage for the LIMES analyser
6	NO	
7	NC	Relay output 2 (unit fault or reagent message BoB)
8	COM	
9	NO	
10	NC	Relay output 1 (limit value alarm)
11	COM	
12	Black (1)	
13	Black (2)	Input contact (INPUT, start or stop analysis interval)



A detailed description of all connections can be found on the following pages.

Electrical installation

Establishing the supply voltage (with junction box):

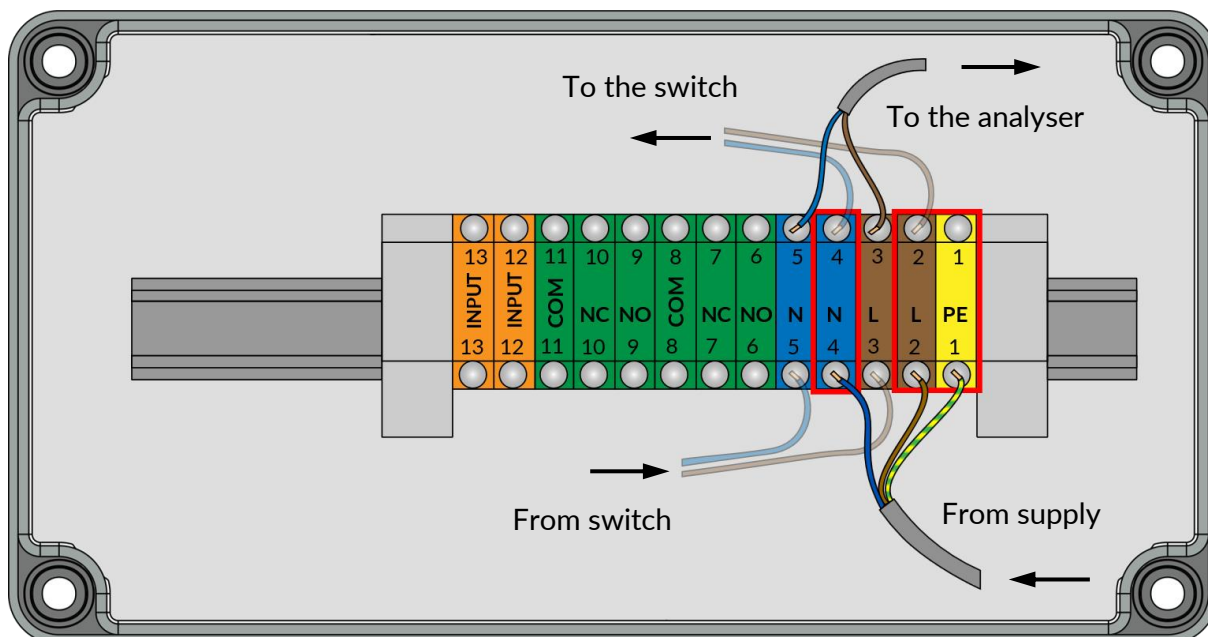


Illustration 10: Electrical installation - supply voltage (junction box)



Voltage

Work on the electrical equipment of the system/machine may only be carried out by a trained electrician!

To establish the supply voltage, proceed as follows:

1. Insert the voltage-free supply line into the junction box
2. Strip the cable (as well as PE, L and N), use wire end ferrules if necessary.
3. Connect PE, L and N according to the illustration (marked red).



Note the further wiring to and from the unit switch as well as to the analyser. Only connect your supply line to the free terminals provided for this purpose.

Establishing the supply voltage (without junction box):

Designation	Colour
L	Brown
N	Blue



Connect the connection cable to your supply voltage in accordance with the applicable standards and guidelines.

Electrical installation

Connecting the relay outputs

Relay output 1 (limit value alarm)

Terminal 11/10/9 - White, Brown, Green

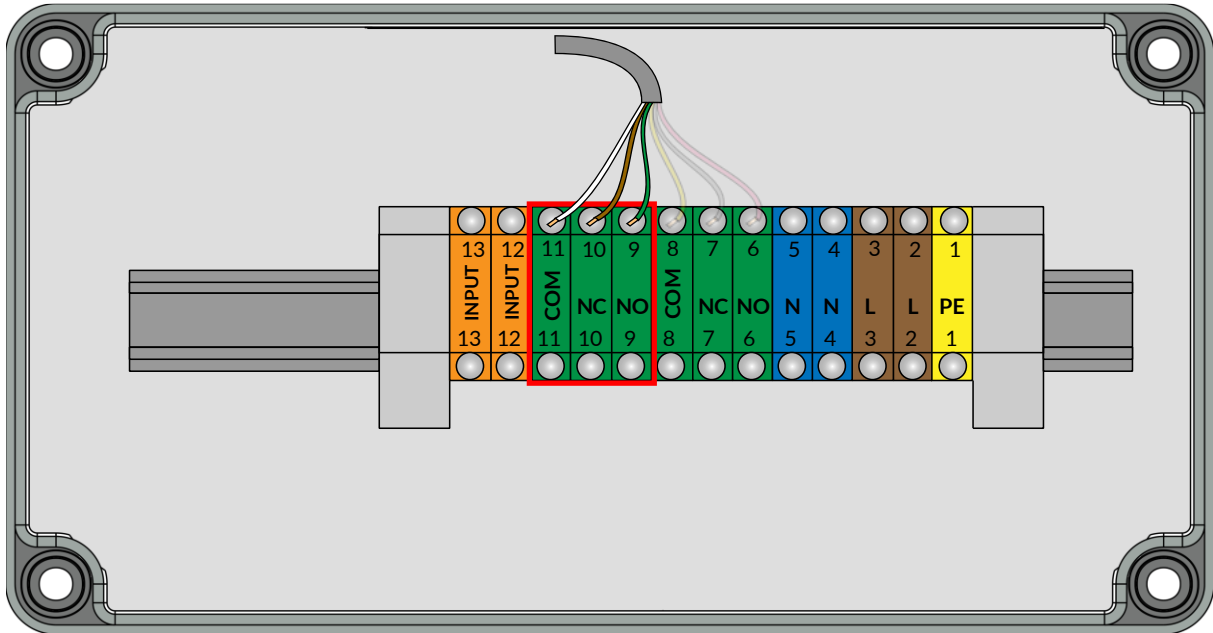


Illustration 11: Electrical installation relay output 1 (junction box)

Relay output 1 is energised when a limit value is exceeded and switches the connection from COM to NO. An indicator light or horn can be connected to relay output 1 to signal a limit violation.

If the limit value is exceeded, relay output 1 remains switched in the position (connection from COM to NO) until the measured water hardness is below the limit value again. Afterwards, the limit value transgression is cancelled again and relay output 1 switches back (connection from COM to NC).

Electrical installation

Relay output 2 (unit fault or reagent message BoB)
Terminal 8/7/6 - Yellow, Grey, Pink

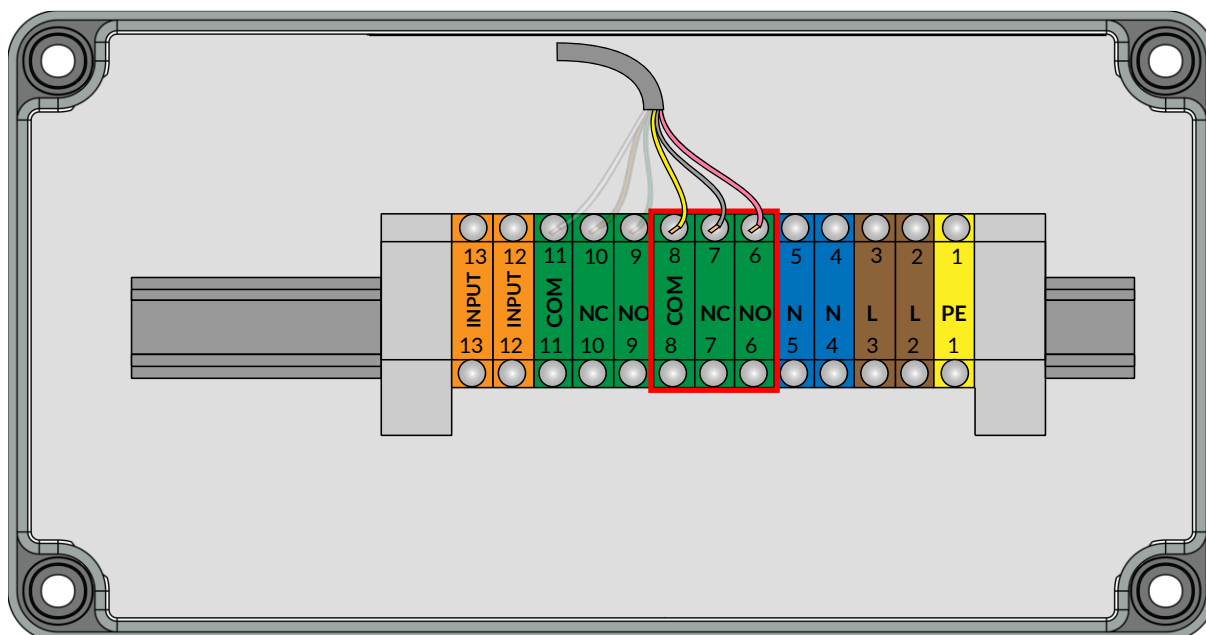


Illustration 12: Electrical installation - relay output 2 (junction box)

Relay output 2 is used to signal unit malfunctions or reagent message BoB (reagent shortage). If the analyser is in normal operation and there is no malfunction, relay output 2 is energised and the connection is switched from COM to NO (wire breakage safety). If a fault is detected, relay output 2 drops out and makes the connection from COM to NC.

Relay 2 is always energized during normal operation:
Connection COM to NO (wire breakage safety)

The following faults are signalled:

- Power failure
 - The analyser is switched off (relay output 2 has dropped out).
- Reagent message
 - The content of the reagent bottle is below approx. 10 %.
- Error zero sample (no sufficient brightness before reagent addition)
 - The measuring chamber is dirty.
 - The sample/measuring water is contaminated or turbid.
 - The electronics are defective.
- Error measurement (no sufficient difference of the measured value before and after the reagent addition)
 - No reagent was dosed.
 - There is no water in the measuring chamber.
 - Mixing did not take place (agitator blade missing or magnetic agitator defective).

Electrical installation

Connection input contact

Input contact (INPUT, start or stop analysis interval)
Terminal 13/12 - Black 2, Black 1

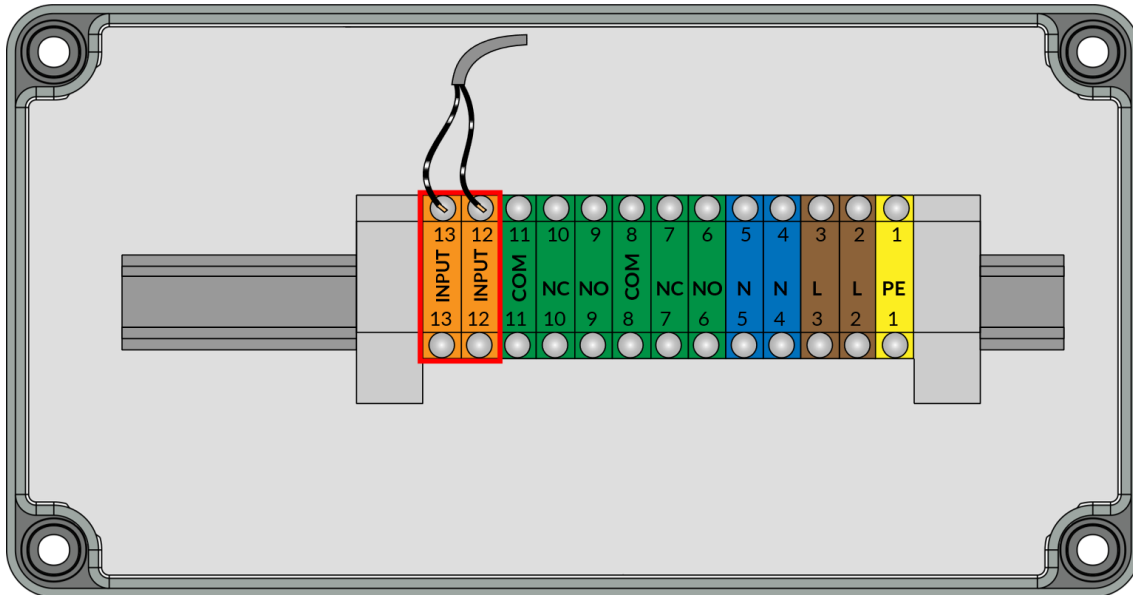


Illustration 13: Electrical installation input contact (junction box)

Potentially free flow monitors, switches or controls can be connected to the input contact to start or pause analyses or to run an analysis interval. No external voltage may be applied to the input contact.

For information regarding the wiring of the input contact, see page 33

Information regarding the function of the input contact depending on the programme switch can be found from page 41



It is recommended to connect the input contact accordingly to avoid unnecessary messages of a limit value exceeding during a regeneration.



Voltage

Only connect potential-free switches to the terminals. Connecting an external voltage source may damage the unit.

Electrical installation

Wiring example 1: Connection to control room (LIMESPlus only)

Attention

- Relay output 1 **picked up** when limit value is exceeded (COM, NO)
- Relay output 2 in case of unit malfunctions or reagent message BoB **dropped out** (COM, NC)
- Circuitry of the input contact (INPUT), see page 33

Drawn position for relay 1 and relay 2: Unit de-energised - Relay de-energised

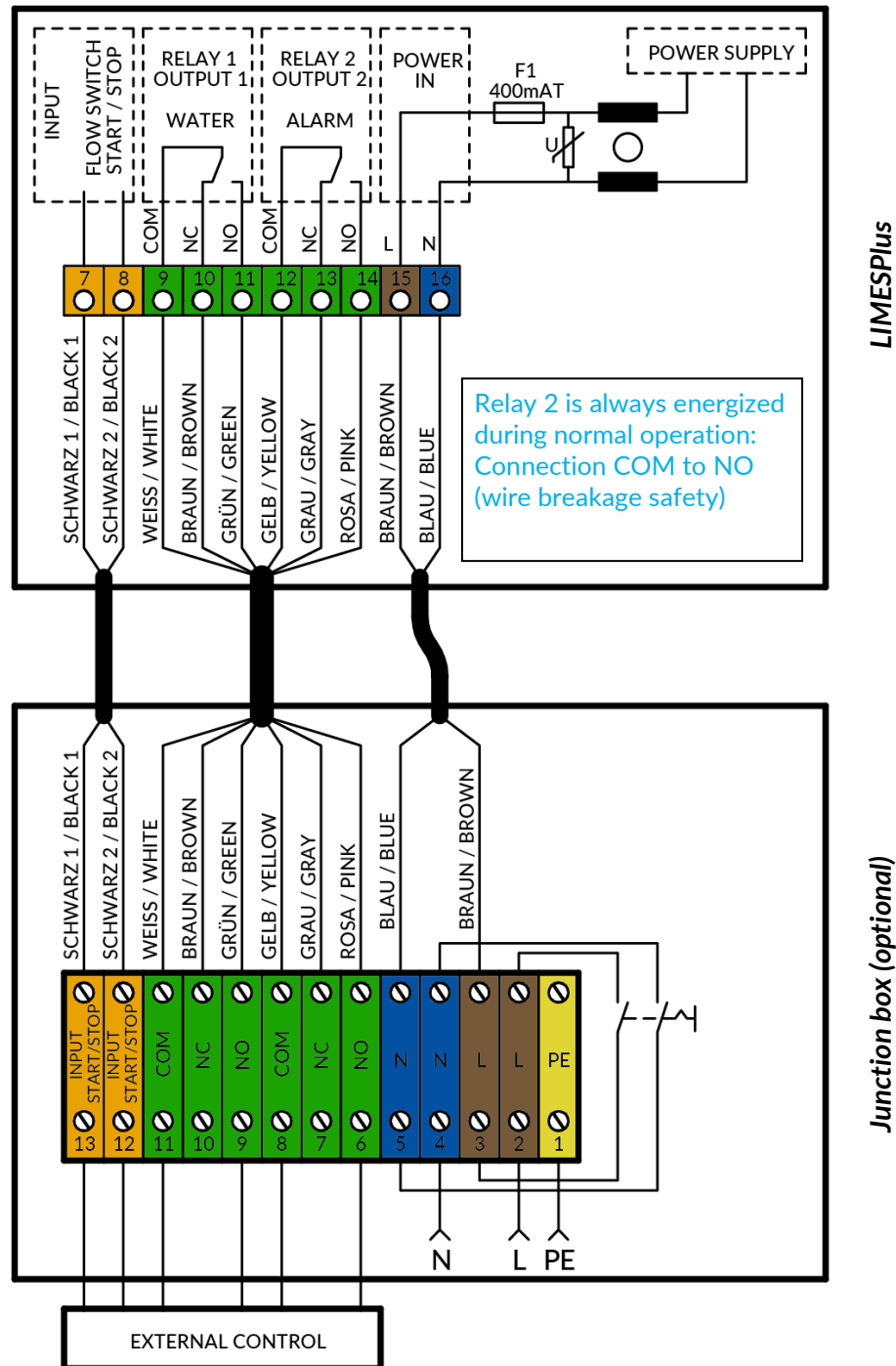


Illustration 14: Circuit diagram 1 - LIMESPlus

Electrical installation

Wiring example 2:

Connection to a reverse osmosis system (connection potential free switch, LIMESPlus)

Connection to an osmosis system:

Relays 1 and 2 are wired as shown in the wiring diagram. In normal operation, there is continuity between terminals 11 and 6 with this wiring. If a limit value violation or a device fault is detected, relay 1 or 2 switches and the continuity between terminals 11 and 6 is interrupted.

Attention

- Relay output 1 **picked up** when limit value is exceeded (COM, NO)
- Relay output 2 in case of unit malfunctions or reagent message BoB **dropped out** (COM, NC)
- Circuitry of the input contact (INPUT), see page 33

Drawn position for relay 1 and relay 2: Unit de-energised - Relay de-energised

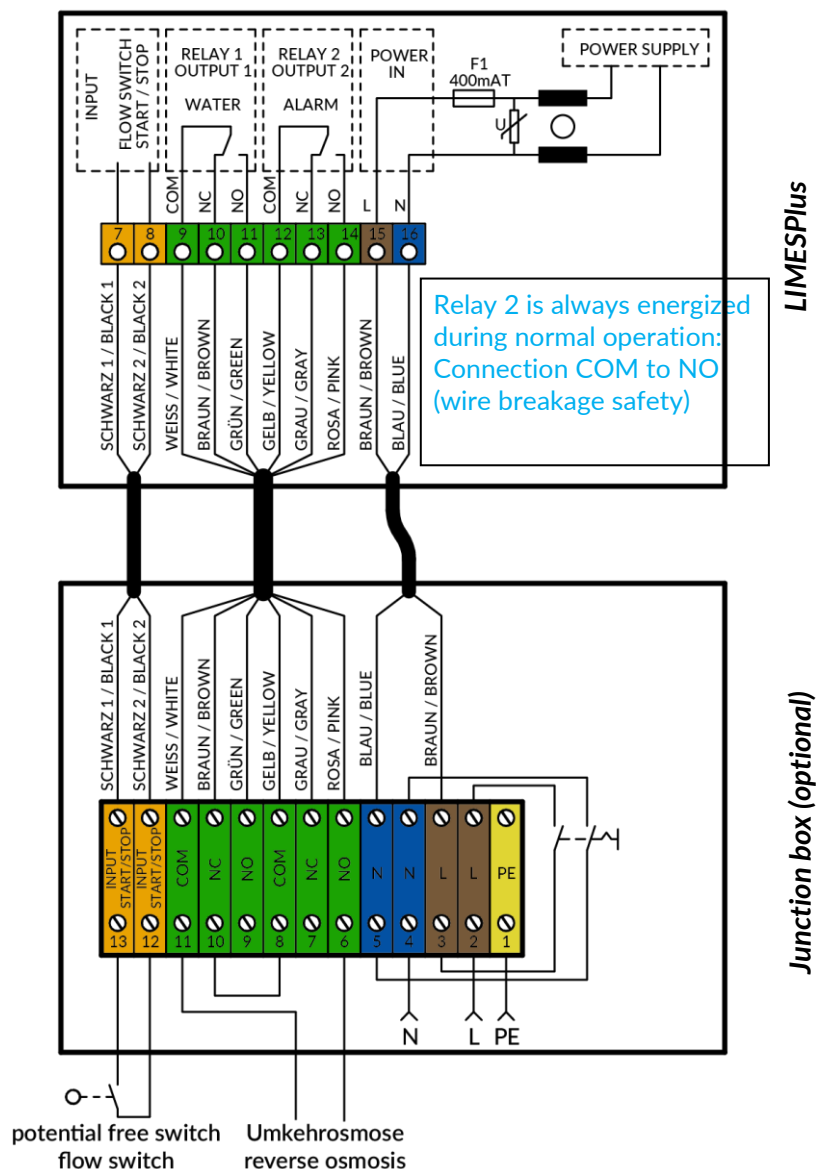


Illustration 15: Circuit diagram 2 - LIMESPlus

Electrical installation

Wiring example 4 and 5: Input contact INPUT (LIMESPlus only)

Potentially free flow monitors, switches or controls can be connected to the input contact to start or pause analyses or to run an analysis interval. No external voltage may be applied to the input contact.

Information regarding the function of the input contact depending on the programme switch can be found from page 41



It is recommended to connect the input contact accordingly to avoid unnecessary messages of a limit value exceeding during a regeneration.



Voltage

Only connect potential-free switches to the terminals. Connecting an external voltage source may damage the unit.

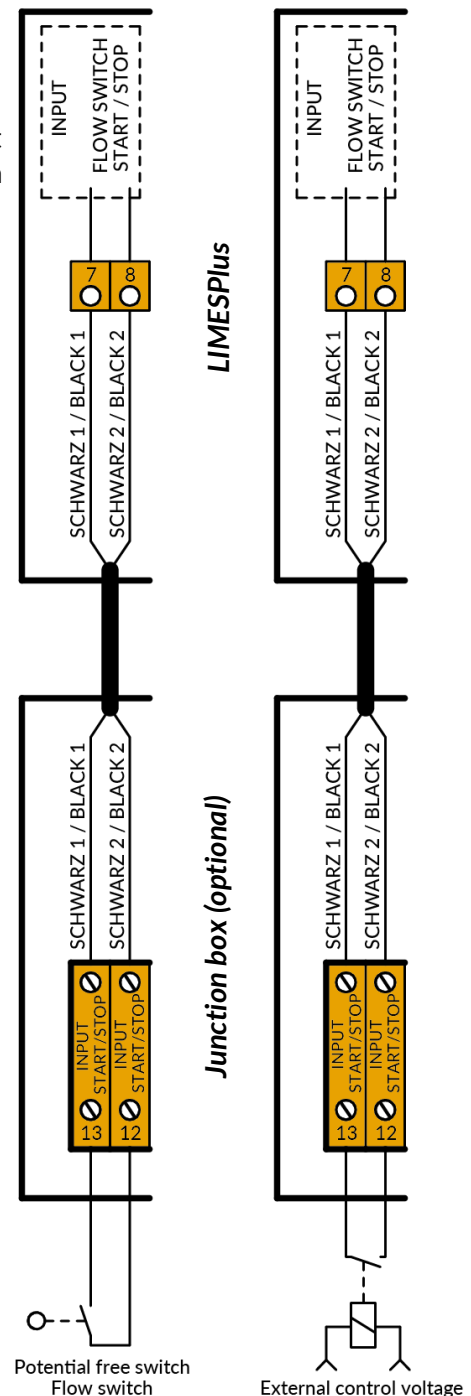


Illustration 17: Circuit diagram 4 and 5 - LIMESPlus

Electrical installation

Wiring Example 6: LIMESBase

Attention

- Relay output 1 **picked up** when limit value is exceeded (COM, NO)
- Relay output 2 in case of unit malfunctions or reagent message BoB **dropped out** (COM, NC)



The input contact function is not active on the LIMESBase. Controls or switches connected to the input contact do not cause analyses to start or stop. To enable the input contact function, you need an upgrade kit, which you can purchase from us. For more information, see page 8, 21 and 68.

Drawn position for relay 1 and relay 2: Unit de-energised - Relay de-energised

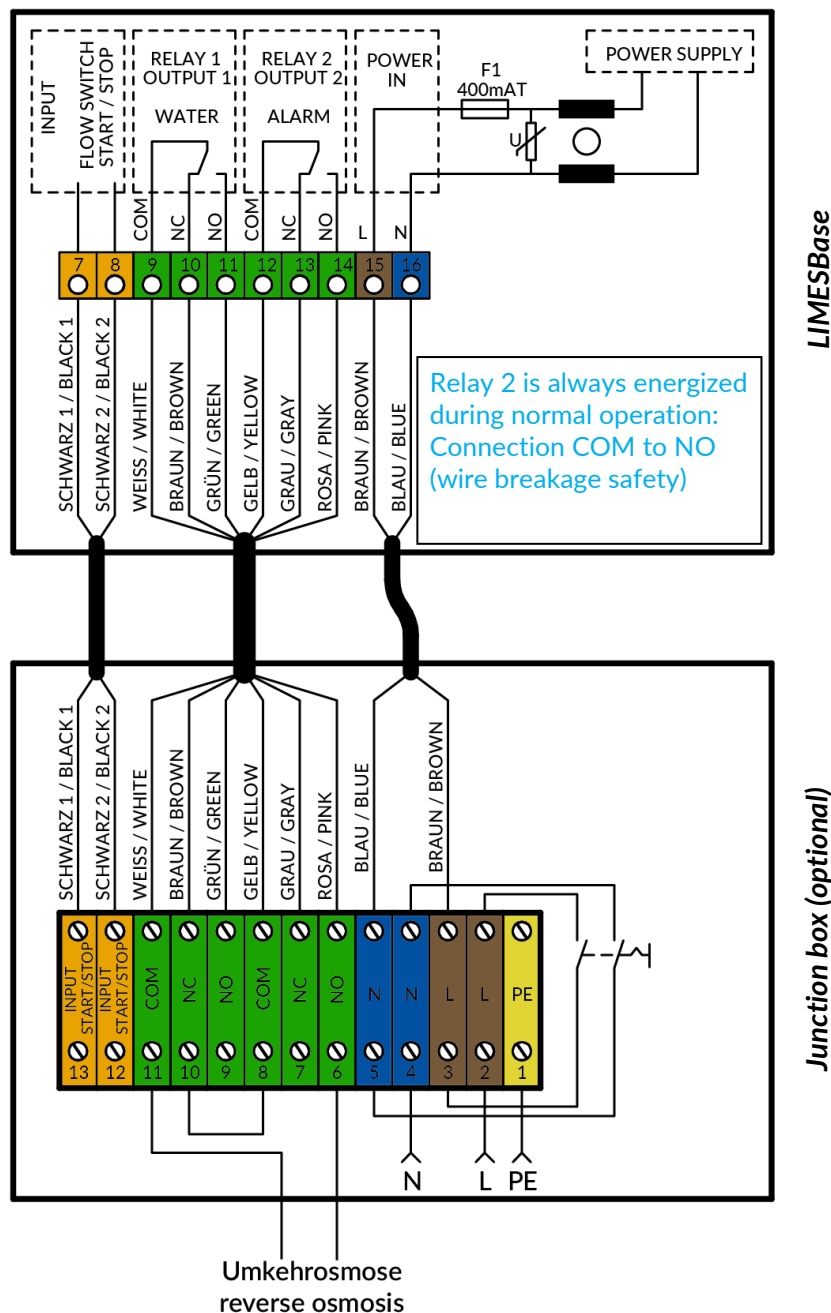


Illustration 18: Circuit diagram 6 - LIMESBase

Operation and handling

Key functions

Analysis start



- You can start an analysis manually.
- When an analysis sequence has been triggered, you can switch to the next analysis step by pressing the START button.
- If an analysis is started manually, any activated relays 1 and 2 are also deleted.

Rinsing and filling the measuring chamber



- Outside of an analysis run, you can rinse the measuring chamber and the supply line to the measuring chamber.

Deaerate dosing pump



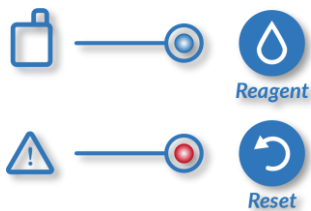
- Outside of an analysis run, you can switch on the reagent pump, e.g., to vent the hose line during commissioning.
- The agitator runs simultaneously with the reagent pump.

Reset - Functions



- Clear relay 1 if the limit value is exceeded.
- Clear relay 2 in the event of a unit malfunction or reagent message BoB.
- You can cancel an analysis run with this key.

Reset reagent level



- By pressing and holding the "Reagent" and "Reset" buttons simultaneously for 4 seconds, you reset the quantity measurement of the reagent. This is necessary after inserting a new full reagent bottle. The reset is done when the LEDs "reagent shortage" (blue) and "device malfunction" (red) light up simultaneously.

For more information on "inserting a new reagent bottle" and "reagent fill level", see page 51 and 53



The reset may only take place if you have inserted a full 750 ml reagent bottle.

Operation and handling

Operating principle

The LIMES based on the SYCON series is an online analyser for the automatic determination of total hardness according to the colorimetric limit value method. By adding a reagent to the water sample, a colour reaction is generated. Depending on the reagent used, the device evaluates the intensity of the colour. By the colour change of the sample after the addition of the reagent, the LIMES monitors the limit value of the water ingredient. The limit value is determined by the reagent used.

Analysis process

The analysis procedure consists of several steps. The duration of each step depends on the configuration of the unit. The first analysis is started automatically 3 minutes after switching on. If the limit value is undershot, the next analyses are carried out at the set analysis interval. The set analysis interval time can only be adhered to if the rinsing time is not set to be longer than the interval time. In the event of a limit value being exceeded, the following measurements are carried out at 8-minute intervals to promptly indicate that the system is ready again after regeneration.

The analysis takes 3 minutes plus the set flush time. A control measurement takes place 4 minutes after completion of the first measurement (first value suppression). A control measurement (first value suppression) is permanently integrated in the LIMESBase and LIMESPlus programme sequence.

Operation with hot sample water

When monitoring hot water, the sample must be cooled to below 40 °C (< 104 °F).

Rinsing the measuring chamber and taking the water samples

The inlet solenoid valve opens. The measuring chamber and the supply line are flushed until it is ensured that there is water from the process to be monitored in the measuring chamber. With the LIMESPlus, the flushing time can be adjusted to the length of the supply line.

Measurement of the zero sample

A zero sample is always taken before the actual measurement begins. The zero sample is used to determine influencing disturbance variables such as sample turbidity, contamination of the optics or extraneous light influences and to be able to take them into account for the evaluation of the water sample. The actuator LED lights up during this process. The solenoid valve is open during the zero sample.

Dosing the reagent into the water sample

The solenoid valve on the device is closed and the reagent is dosed into the water sample. By turning the stirring blade, the reagent is homogeneously dissolved in the water sample.

Operation and handling

Measurement of the water sample with reagent

In this step, the value is determined from the colouring of the water sample. For this purpose, the stirring blade is stopped. The actuator board LED lights up and the evaluation of the water sample takes place immediately. The result of the measurement is displayed on the LEDs on the front of the unit.

In case of incorrect values, e.g., missing reagent addition, a device fault is output.

Rinsing and cleaning the measuring chamber

The solenoid valve opens, flushing out the coloured water sample. The measuring chamber remains filled with pure process water until the next analysis begins.

Operation and handling

Before commissioning



- Make sure that the unit is well secured to a wall or suitable suspension.
- Ensure that the water quality meets the specified requirements. If necessary, take suitable measures to improve the supply water quality (e.g., installation of an activated carbon filter).
- Make sure that a full reagent bottle is inserted.
- Check that the Leur connections of the peristaltic pump cassette to the measuring chamber and the bottle have been screwed on tightly.
- Check that the correct reagent type is used for the application.
- Check that the expiry date of the reagent has not expired.
- Make sure that all water-bearing parts are tight and that the inlet and outlet are connected the right way round.
- Make sure that the water treatment plant to be monitored is in operation and supplying sample water.
- Make sure that the maximum permissible operating pressure on the water supply line is not exceeded. If necessary, fit a throttle valve.
- If in doubt, consult a specialist or contact your supplier or the manufacturer.



Make sure that the input and output contacts of the analyser are connected in the desired way to the water treatment plant to be monitored.



Make sure that the electrical connections are mounted correctly.
If in doubt, consult a specialist or contact your supplier or the manufacturer.

Voltage

Operation and handling

Device settings

The LIMESPlus analyser is programmed via small slide switches (programme switches SW1 - SW4) and adapted to the operating requirements. (SW = switch/switch)



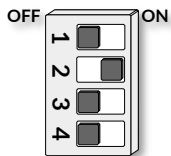
Voltage

Disconnect the unit from the power supply and remove the rubber cover of the analyser.

The programme switches are located behind the rubber cover. The 16-step rotary switch for setting the rinse time and the programme switches SW are located on this board.



Setting	Factory setting	
Flushing time	Position 6	4 minutes



Setting	Factory setting	
Analysis interval	SW1 OFF SW2 ON	10 minutes
Input contact	SW3 OFF	From
Diagnostic mode	SW4 OFF	From



Voltage

Work on electrical connections may only be carried out by authorised specialist personnel in compliance with the locally applicable regulations.




You need a small screwdriver to operate the rotary switches and to set the programme switches SW (slide switches). Please use only suitable and tested tools to avoid damage to the sensitive components.

Operation and handling

Setting the flushing time LIMESPlus

In the LIMESPlus unit variant, the flushing duration can be set in the range of 5 seconds to 30 minutes using the rotary switch "Flushing duration" before the start of an analysis.

Flushing
time



Position	Time
0	5 sec.
1	10 sec.
2	20 sec.
3	50 sec.
4	90 sec.
5	2 min
6	4 min
7	8 min
8	10 min
9	12 min
A	14 min
B	16 min
C	18 min
D	20 min
E	25 min
F	30 min

Select the flushing time depending on the length of the supply line to ensure that the water from the softener flushes the supply line free and fresh water is analysed.

A long rinsing time also reduces build-up in the measuring chamber.

The local conditions of a system can be very different: different pipe cross-sections to the softener, fluctuating pressure conditions due to strong consumers etc.

Measure the amount of flushing water at the currently set flushing duration and compare it with the theoretically calculated amount of water based on the pipe cross-sections. Take into account an allowance for the resin bed volume.

Use this to ensure that a representative water sample is always analysed.



We recommend a rinsing time of at least 50 seconds.

Setting the flushing time LIMESBase

The LIMESBase is supplied with a fixed programmed flushing time of 50 seconds. To activate the flushing time, you need an upgrade kit, which you can purchase from us.




For more information, see page 8, 21 and 68

Operation and handling

Analysis interval LIMESPlus depending on the input contact INPUT

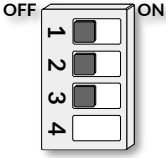



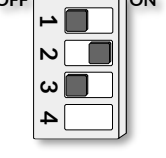



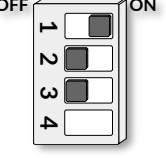



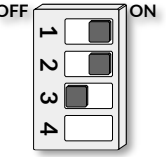



There are 4 fixed interval times that are set via the programme switches SW1 and SW2. The interval time is the time between 2 consecutive analysis starts. If the input contact is open, no analyses are started in the set analysis interval. Therefore, this input is bridged in the delivery state. The bridge or an external switch (e.g., flow monitor) must be connected and closed when the water is flowing in order to carry out analyses in the analysis interval.

Symbols used:

INPUT Input contact	State	Description
	Closed	The input contact is permanently closed
	Open	The input contact is permanently open
	Pulse	Only one analysis is carried out

Setting for the use of a switch or flow monitor

Internal analysis interval time, **input contact deactivated (SW3 OFF)**

SW programme switch position	INPUT Input contact	Function
		Analyses are carried out at 5 min intervals
		Paused: No analyses are carried out because the input contact is open.
		Only one analysis is carried out
		Analyses are carried out at 10 min intervals
		Paused: No analyses are carried out because the input contact is open.
		Only one analysis is carried out
		Analyses are carried out at 20 min intervals
		Paused: No analyses are carried out because the input contact is open.
		Only one analysis is carried out
		Analyses are carried out at 30 min intervals
		Paused: No analyses are carried out because the input contact is open.
		Only one analysis is carried out

Operation and handling

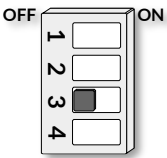
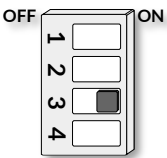
Analysis interval LIMESBase

The LIMESBase is supplied with a fixed analysis interval time of 10 minutes. To unlock the analysis interval time, you need an upgrade kit, which you can purchase from us.

For more information, see page 8, 21 and 68

Input contact LIMESPlus (INPUT, start or stop analysis interval)

Different functions can be assigned to the input contact.

Programme switch	SW3	Function
	OFF	<ul style="list-style-type: none">Flow monitor, switch or bridge, internal analysis interval timeNo analysis with open input contact <i>For more information, see page 41</i>
	ON	<ul style="list-style-type: none">External analysis start depending on SW1 and SW2 switch positionNo analysis with open input contact depending on SW1 and SW2 switch position

Flow monitor

This function is used if analyses are only to be carried out as soon as a water withdrawal takes place. This is particularly useful for discontinuous operation, i.e., filling up a storage tank at longer intervals or for systems that are only in operation for a few hours a day. The function is also used when no analyses are desired, e.g., during the regeneration of a single-filter system. *For more information, see page 41*

External analysis start

The input contact is used in conjunction with a controller in the operating mode "external analysis start". An analysis is started by pulse control on the input contact.



Voltage

Note that the input contact must always be a potential-free switch. Connecting an external voltage source can damage the unit.



Instead of a flow monitor, you can also use any other potential-free contact of a timer or a relay (osmosis control, softening control).



In the delivery state, the programme switch SW3 = OFF and the input contact is bridged, so that the internal analysis interval is active.

Operation and handling



If the input contact is permanently bridged while the programme switch SW3 is ON, analyses are carried out continuously. The analyses are carried out consecutively. The set internal analysis interval is deactivated.

Symbols used:

INPUT Input contact	State	Description
	Closed	The input contact is permanently closed
	Open	The input contact is permanently open
	Pulse	Only one analysis is carried out

Setting for the use of an external control depending on SW1 and SW2 switch position

External analysis start, **input contact activated (SW3 ON)**

SW programme switch position	INPUT Input contact	Function
		Analyses are carried out continuously without pauses
		Paused: No analyses are carried out because the input contact is open.
		Only one analysis is carried out
For pulsed operation		Analyses are carried out continuously without pauses
		Analyses are carried out at 10 min intervals
		Only one analysis is carried out
		Analyses are carried out continuously without pauses
		Analyses are carried out at 20 min intervals
		Only one analysis is carried out
		Analyses are carried out continuously without pauses
		Analyses are carried out at 30 min intervals
		Only one analysis is carried out

Operation and handling

The following examples should make it easier for you to choose the right setting:

Example 1: Analyses are to be carried out continuously at a fixed time interval

In this case, the programme switch SW3 = OFF and no flow monitor is connected. The input contact is provided with a jumper instead.

Example 2: Analyses are carried out at a fixed time interval when a flow monitor reports flowing water

The programme switch SW3 is in the OFF position. The flow monitor is connected to the input contact INPUT instead of the jumper. The first analysis after switching on the unit takes place after 3 minutes, even if the flow monitor reports no flowing water. The subsequent analyses only take place if there is flowing water in the set interval. The pausing of the analysis interval by the flow monitor is indicated by the yellow LED flashing. If the flow monitor reports flowing water after a standstill period, an analysis is carried out immediately.

Example 3: The analysis is started by an external controller

To preset the analysis interval by a control, the control is connected to the input contact by means of a potential-free switch. The programme switch SW3 is set to the ON position (external analysis start) to start analyses by a switching pulse at the input contact. If the input contact is permanently bridged, analyses are carried out continuously.

Usually, the programme switches SW1 and SW2 are also set to OFF, thus deactivating the internal analysis interval.

Input contact LIMESBase

With the LIMESBase, the function of the input contact is not active. Controls or switches connected to the input contact do not start or stop analyses. To enable the input contact function, you need an upgrade kit, which you can purchase from us.

For more information, see page 8, 21 and 68

Operation and handling

First value suppression

After a limit value has been exceeded, a reference measurement is carried out every 4 minutes to evaluate the result. This prevents false alarms due to the counter ion effect after a system shutdown.

The LIMESBase and the LIMESPlus are factory-equipped with a fixed activated first value suppression.

Trigger conditions for an analysis start



- Automatically by the set analysis interval
- Manual analysis by pressing the "Start" button
- 3 minutes after switching on the unit
- 4 minutes after a limit value has been exceeded
- Switching on a connected flow monitor after system standstill
- Through a connected external control

Operation and handling

Commissioning



Make sure that the analyser is installed according to the instructions and that the programme switches SW1-SW4 are programmed according to the desired requirements.

Switching on the unit

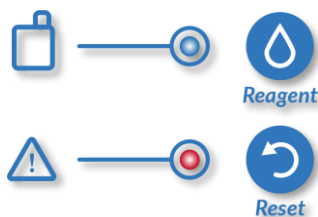
- Switch on the power supply e.g., via the optional connection box.
- The calculated level of the reagent bottle is displayed for one second. *See page 51.*

After switching on



- The green LED "limit value" flashes because no measurement has been carried out yet.
- When the input contact is open, the yellow LED "Input contact open" also flashes.

Insert a full reagent bottle and reset reagent level



- Insert a full reagent bottle into the LIMES
- Press and hold the "Reagent" and "Reset" buttons simultaneously until the LEDs "Reagent deficiency" (blue) and "Device malfunction" (red) light up simultaneously
For more information, see page 53



Only reset the fill quantity if you have inserted a full bottle

Deaerate dosing pump



- Press and hold the "Reagent" button for 10 seconds to pump reagent from the newly inserted bottle into the measuring chamber and to push the air bubbles out of the tube.
(During this time the stirring blade rotates).

Filling the measuring chamber with water



- Press the "Valve" button until the measuring chamber has filled with water.

Operation and handling

Start analysis



- Press the START button to start the first analysis.
- An analysis starts with rinsing the measuring chamber.

LED indicators

By means of the 4 LEDs, the LIMES analyser displays information on the operating status and results of the measurements and provides information on the level of the reagent.

The unit status is indicated by 4 LEDs on the front of the unit.

The following indicators can be displayed during operation depending on the configuration. The display variants of the blue LED (reagent notes) can occur in combination with the other LEDs depending on the fill level of the reagent bottle.

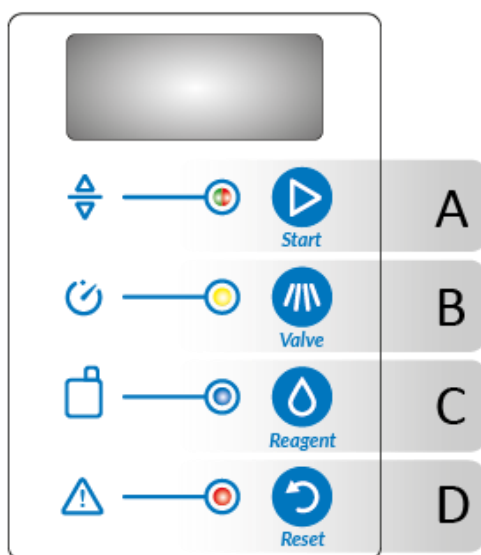
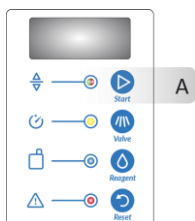


Illustration 19: LIMES LED display front / operating front









The LED display shows the operating status:

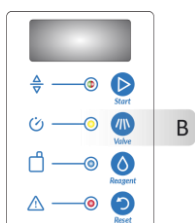
LED	Colour	Information
A	Green (two-colour LED)	Limit value undershot
A	Red (two-colour LED)	Limit value exceeded
B	Yellow	Analysis active
B	Yellow flashing	Input contact open, e.g., by flow monitor
C	Blue	Provide reagent
C	Flashing blue	BoB message
D	Red	Device fault

Operation and handling







Description of the two-colour red/green LED (A) "Limit value

LED display (A)	Description
Green-flashing  	<p>There is no analysis result because the unit has just been switched on. Relay 1 "limit value" has dropped out. (Limit value undershot)</p>
Green-glowing  	<p>The water quality is below the specified limit. Relay 1 "limit value" has dropped out. (Limit value undershot)</p>
Flashing red  	<p>The specified limit value was exceeded. Relay 1 "Limit value" is energised. (Limit value exceeded)</p> <p>The relay 1 position can, however, be deleted by pressing the "Reset" button; in this case, the relay drops out, but the red LED (A) remains flashing. The relay 1 position can be seen on the LED combination of LED (A) and LED (D) can be read. See "Description of relay 1 position LED combination LED (A) and LED (D)".</p>
Red-glowing  	<p>The limit value has been exceeded, but relay 1 has not yet been energised (first value suppression - the analysis is repeated in 4 minutes).</p>



Description of the yellow LED (B) "Analysis active / input contact

LED display (B)	Description
Yellow-flashing  	<p>The display flashes to indicate that the analysis interval has expired, but that the start of the analysis is blocked via the input contact (flow monitor function).</p>
Yellow-glowing  	<p>The indicator lights up permanently to signal that an analysis has been started.</p>

Operation and handling



Description of the LED combination LED (C) blue, LED (D) red "Reagent message / BoB message".

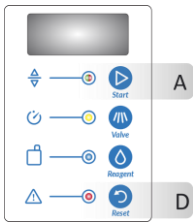
LED display (C) and (D)	Description
Blue-glowing 	<p>The indicator lights up permanently, signalling that the reagent supply is less than approx. 30 %. The remaining amount of reagent allows operation for another 72 hours in the set analysis interval. Prepare a new reagent bottle.</p>
LED (C) Blue flashing LED (D) Red-flashing 	<p>The BOB alarm is active. The display signals a reagent level that may no longer be sufficient for unattended operation in the set analysis interval (BoB) over 72 hours.</p> <p>Relay 2 "Device fault / reagent message BoB " has dropped out.</p> <p>To acknowledge the BoB alarm, press the "Reset" button.</p>
LED (C) Blue flashing LED (D) Red-glowing 	<p>The indicator signals a reagent level that may no longer be sufficient for unattended operation for 72 hours. The BoB message has already been acknowledged with the "Reset" button.</p> <p>Relay 2 "Device fault / reagent message BoB " is energised.</p>



Description of the red LED (D) "Device malfunction"

LED display (D)	Description
Flashing red 	<p>The display signals a unit malfunction:</p> <ul style="list-style-type: none"> Faulty zero sample or faulty measurement All other displays are switched off. <p>To acknowledge the unit fault, press the "Reset" button or switch the unit off and on again.</p> <p>Relay 2 "Device fault / reagent message BoB " has dropped out.</p>

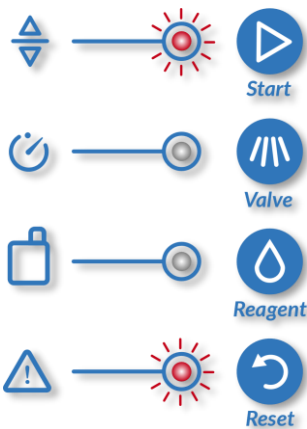
Operation and handling



Description of relay 1 position LED combination LED (A), LED (D) "limit value exceeded"

LED display (A) and (D)	Description
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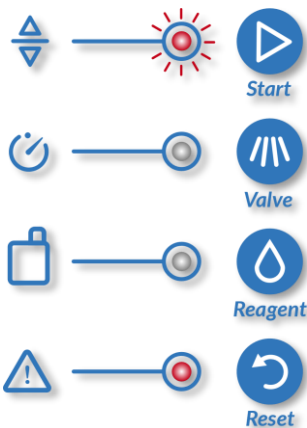
LED (A) Red-flashing
LED (D) Red-flashing



Limit value LED (A) flashing red and at the same time device malfunction LED (D) flashing red: Signals that the preset limit value has been exceeded and that relay 1 is energised.

Relay 1 "Limit value" is energised. (Limit value exceeded)

LED (A) Red-flashing
LED (D) Red-glowing



Limit value LED (A) red-flashing and at the same time device malfunction LED (D) red-illuminated: Signals that the specified limit value has been exceeded, but relay 1 has been deleted by pressing the "Reset" button.

Relay 1 "limit value" has dropped out.

Operation and handling

LED display reagent level

After switching on the analyser, the calculated level is displayed for 1 second:

LED display	Description
	<p>100 % The following LEDs light up: green, yellow, blue, red</p> <p>Immediately after resetting the reagent counter: Up to 10,000 analyses are possible.</p>
	<p>100 % - 75 % The LEDs light up: red, yellow, blue, red</p> <p>More than 7500 analyses are possible.</p>
	<p>75 % - 50 % The LEDs light up: yellow, blue, red</p> <p>More than 5000 analyses are possible.</p>
	<p>50 % - 25 % The following LEDs light up: blue, red</p> <p>More than 2500 analyses are possible.</p>
	<p>25 % - 0 % The red LED lights up</p> <p>Less than 2500 analyses are possible until the reagent bottle is changed.</p>

Maintenance and service

To ensure long-term and trouble-free operation of the LIMES analyser, it is necessary to clean the measuring chamber and replace wearing parts.

Therefore, we recommend:

- A weekly visual inspection of the unit
- Cleaning the measuring chamber at least every 6 months
- Installation of a maintenance set after 24 months



Maintenance can be carried out in a simple manner. We recommend that maintenance be carried out by a trained specialist. In any case, please observe the following safety instructions.



Ideally, carry out the maintenance work in conjunction with the maintenance of the treatment plant or during a break in operation.



Before servicing, switch off the unit by pressing the mains switch or disconnecting the supply voltage.



Voltage

Depending on the wiring, some terminals may be energised with 230 volts when the mains switch is switched off.

One touch can have serious consequences:

- Danger to life
- Risk of injury
- Damage to the appliance due to improper handling



No analyses are carried out during maintenance and therefore a possible hardness breakdown cannot be detected.



Close the inlet valve to the analyser before working on the measuring chamber.

- Water splashes could destroy the electronics.



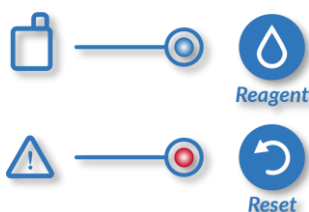
Irritant

Ensure that your eyes, skin and clothing do not come into contact with the reagent.

- Follow the instructions in the safety data sheets.
- Suitable protective clothing is required during maintenance work:
 - Workwear
 - Laboratory gloves
 - Eye protection

Maintenance and service

Inserting a full reagent bottle



1. Open the reagent bottle by twisting off the cap. Insert the suction lance into the new bottle and screw the cap tight.
2. Insert the full reagent bottle into the LIMES.
3. Set the reagent level to 100 %. To do this, press the "Reagent" and "Reset" buttons simultaneously and keep them pressed until the LEDs "Reagent low" (blue) and "Device fault" (red) light up simultaneously. For more information on the subject of "Reagent level" see page 51
4. Now press and hold the "Reagent" button for 10 seconds to pump reagent from the newly inserted bottle into the measuring chamber and to press the air bubbles out of the tube.



The reagent bottle is not included in the scope of delivery of the unit.

- Use only original reagent type LHV in the 750 ml bottle.
- Check the shelf life of the reagent used.



Danger of pollution

When handling the reagent, make sure that your eyes, skin and clothing do not come into contact with the liquid.

Irritant

- Observe the instructions in the safety data sheets.

We accept no liability for permanent soiling caused by the dyes in the reagent or personal injury resulting from improper handling of the reagent.



We recommend wearing suitable protective clothing when handling the reagent:

- Workwear
- Laboratory gloves
- Eye protection / safety goggles

Maintenance and service

Install maintenance set / clean measuring chamber

Time: approx. 30 minutes
Material: Maintenance set for LIMES
LIMES Clean cleaning set
Paper towels
Tools: Ring spanners 8 and 16mm,
Allen screwdriver with 2.5mm



Irritant

Ensure that your eyes, skin and clothing do not come into contact with the reagent. Protective clothing required:

Work clothes, laboratory gloves, eye protection

Dismantle / Clean:

- Switch off the LIMES
- Connect the hand valve to the LIMES (The hand valve must be installed by the system operator upstream of the LIMES in the supply line).
- Loosen the reagent connection on the measuring chamber
- Remove the measuring chamber to the front from the housing (measuring chamber is held in the housing by magnets).
- Disconnect the inlet and outlet hoses from the measuring chamber.
- Then dismantle the measuring chamber into its individual parts:
 - 4x screws A2 M4 x 65
 - 3x measuring chamber components
 - 1x plastic tube (transparent)
 - 2x O-rings 24 x 2.5
 - 2x inlet/outlet screw connection
 - 2x O-rings 9 x 1.6
 - 1x injector
 - 1x O-ring 5.28 x 1.78
 - 1x stirrer blade
- Place the three measuring chamber components in the FIT 3000 cleaning liquid for approx. 10 minutes and then clean the parts with the brush
- Rinse the parts under running water afterwards

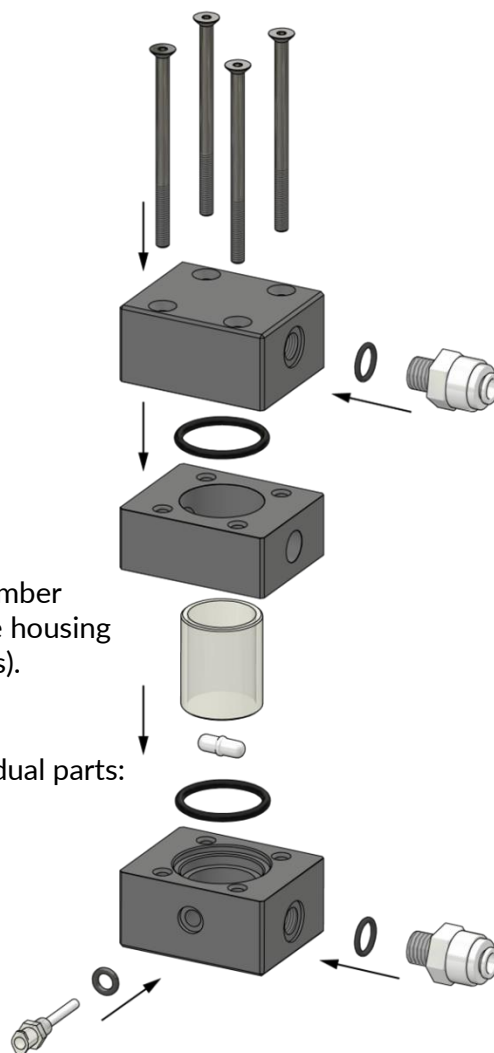


Illustration 20: measuring chamber

Assembly: Only insert new parts from the maintenance set.

- First insert the transparent plastic tube into the middle part of the measuring chamber and slide a greased O-ring onto the top and bottom of the tube.
- Now place the stirring blade in the lower part of the measuring chamber
- Now place the three measuring chamber components on top of each other and tighten them with the 4 screws. *Torque 0.6Nm.*
- Push the O-rings onto the inlet/outlet fitting and grease it, then screw it into the measuring chamber. *Torque 1Nm.*
- Push the O-ring onto the injector and grease it, then screw it into the measuring chamber. *Torque 0.2Nm.*
- Now connect the measuring chamber to the inlet/outlet hose.

Maintenance and service

- Insert the measuring chamber into the housing
- Place a new hose pump cassette on the motor shaft and connect the hose to the measuring chamber
- Unscrew the suction lance from the bottle adapter and insert a new suction lance
- Connect the suction lance to the hose pump cassette

Commissioning:

After maintenance, reagent must be pumped from the bottle into the measuring chamber and the measuring chamber must be rinsed.

- Now open the hand valve
- Switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free reagent into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose

Maintenance is now complete.

Change peristaltic pump cash register

To ensure the measuring accuracy of the LIMES analyser, the peristaltic pump cassette should be replaced after 24 months.

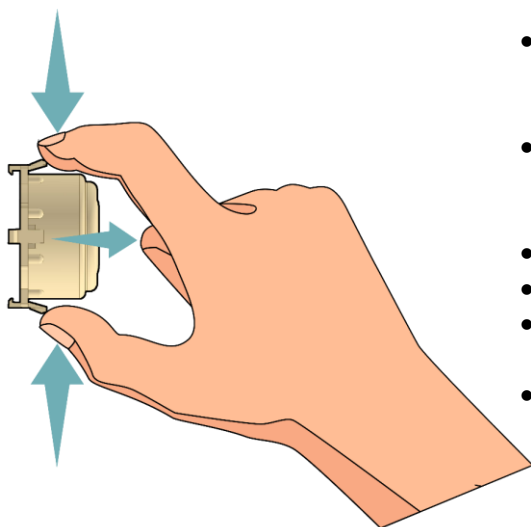


Illustration 21: Change dosing pump

- Press the locking tabs together with your thumb and index finger and pull the hose pump cassette off the motor shaft.
- Disconnect the tube connection to the measuring chamber and reagent bottle by turning the Luer connector.
- If reagent liquid leaks out, remove it with a paper towel.
- Put a new hose pump cassette on the motor shaft.
- Make the tube connection to the measuring chamber and reagent bottle by turning the Luer connector.
- Deaerate the peristaltic pump cassette: Switch on the unit and press the "Reagent" button for about 10 seconds until the peristaltic pump pumps bubble-free reagent into the measuring chamber.

You will find a spare parts list from page 65



Irritant

Ensure that your eyes, skin and clothing do not come into contact with the reagent. Follow the instructions in the safety data sheets. Suitable protective clothing is required during maintenance work:

- Workwear
- Laboratory gloves
- Eye protection

Maintenance and service

Component exchange



Observe the applicable accident prevention regulations.



Voltage

The unit and the supply line to the unit must be disconnected from the power supply and secured against being switched on again.



Irritant

Wear appropriate protective equipment to avoid skin contact with the reagent.



Pressure

Shut off the water supply before starting work.

Replacing the filter / pressure regulator / solenoid valve

Tools required when replacing the solenoid valve:

Screwdriver Torx T10, T20 and a phase tester

Preparation:

- Ensure a pressureless supply. (Close the hand valve)
- Loosen the hose connection to the inlet and outlet on the LIMES
- Switch on the unit briefly.
- Press and hold the "Valve" button. By opening the solenoid valve, you relax the supply line, and the measuring chamber empties.
- Hold a small container under the inlet and outlet.
- Switch the unit off again.

Only when replacing the filter or pressure regulator:

- Loosen and remove the bulkhead screw connection at the inlet and outlet
- Remove the component, filter or pressure regulator to be replaced.
- Install the new component
(Note the direction of flow, the arrows on the component point in the direction of the measuring chamber).
- Reassemble the unit and put it into operation.




Note the correct flow direction and placement of the components. *See page 18*

Only when replacing the solenoid valve:


- Disconnect the LIMES and the connection box from the power supply!
- Loosen the reagent connection on the measuring chamber and the reagent bottle
- Remove the reagent bottle
- Remove the measuring chamber to the front from the housing
(measuring chamber is held in the housing by magnets).
- Disconnect the inlet and outlet hoses from the measuring chamber.
- Remove the analyser from the wall

Maintenance and service

- Remove the electronics cover on the back of the analyser
- Disconnect the electrical connection of the solenoid valve on the main board
- Detach the solenoid valve from the plastic plate
- Attach a new solenoid valve to the plastic plate
(Note the direction of flow, the arrow on the component points in the direction of the measuring chamber)
- Guide the electrical connection of the new solenoid valve through the opening provided in the housing
- Connect the new solenoid valve according to the previous assignment on the main board.
See page 22
- Reassemble the unit and put it into operation.

 After replacing the solenoid valve, the reagent must be pumped from the bottle into the measuring chamber and the measuring chamber must be rinsed.

- Now open the hand valve
- Switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free reagent into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose

 Observe the electrical connection according to the illustration on page 22


Exchange of the measuring chamber

Preparation:

- Ensure a pressureless supply. (Close the hand valve)
- Loosen the hose connection to the inlet and outlet on the LIMES
- Switch on the unit briefly.
- Press and hold the "Valve" button. By opening the solenoid valve, you relax the supply line, and the measuring chamber empties.
- Hold a small container under the inlet and outlet.
- Switch the unit off again.

Only when replacing the measuring chamber:

- Loosen the reagent connection on the measuring chamber
- Remove the measuring chamber to the front from the housing
(measuring chamber is held in the housing by magnets).
- Disconnect the inlet and outlet hoses from the measuring chamber.
- Replace the measuring chamber and reassemble the unit

 After a measuring chamber exchange, reagent must be pumped from the bottle into the measuring chamber and the measuring chamber must be rinsed.

- Now open the hand valve and switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free reagent into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose

Replacing the peristaltic pump motor / agitator drive / actuator board (LED)

Required tools: Torx T10 screwdriver and a phase tester

Preparation:

- Ensure a pressureless supply. (Close the hand valve)
- Loosen the hose connection to the inlet and outlet on the LIMES
- Switch on the unit briefly.
- Press and hold the "Valve" button. By opening the solenoid valve, you relax the supply line, and the measuring chamber empties.
- Hold a small container under the inlet and outlet.
- Switch the unit off again.
- Disconnect the LIMES and the connection box from the power supply!
- Loosen the reagent connection on the measuring chamber and the reagent bottle
- Remove the reagent bottle
- Remove the analyser from the wall
- Remove the electronics cover on the back of the analyser

Only when replacing the peristaltic pump motor:

- Disconnect the electrical connection on the main board
- Pull the hose pump cassette off the motor shaft
- Loosen the two screws on the front of the unit
- Replace the peristaltic pump motor
- Connect the new peristaltic pump motor according to the previous pinout on the main board. *See page 22*
- Reassemble the unit and put it into operation.

Only when replacing the agitator drive or actuator board (LED)

- Disconnect the electrical connection on the main board
- Pull or lever out the component
- Replace the component
(The cables from the body of the stirrer motor point in the direction of the housing).
- Connect the component according to the previous assignment on the main board. *See page 22*
- Reassemble the unit and put it into operation.



After replacing the components described above, reagent must be pumped from the bottle into the measuring chamber and the measuring chamber must be rinsed.

- Now open the hand valve
- Switch on the LIMES
- Press and hold the "Reagent" button until the peristaltic pump pumps bubble-free reagent into the measuring chamber. (Takes about 10 seconds)
- Press and hold the "Valve" button until clear water flows out of the drain hose



Observe the electrical connection according to the illustration on page 22

Maintenance and service

Diagnostic functions LIMESPlus

The diagnostic programme is used to check the unit functions. This is available in the LIMESPlus version.

This test may only be called up by qualified persons. Please observe the following safety instructions!



Make a note of the positions of the programme switches before the diagnosis and switch all programme switches back to the original position after the diagnostic programme has been carried out.



Use the service booklet to note down your settings.

The test must be carried out with the front cover open, and the rubber cap removed. All buttons and switches are operated.



Voltage

When running the diagnostic programme, please note the following:

- Depending on the wiring, the cables of relays 1 and 2 exiting the LIMES may be connected to mains voltage.
- Touching it can lead to serious injuries.
- There is danger to life.
- The unit can be damaged by improper handling.



Activation of relay 1 and relay 2 can lead to operating faults.

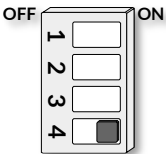


Pressure

Note that the supply line is under pressure.

Avoid splashing water that could get into the electronics and destroy them.

Switch SW4 to the ON position. The diagnostic functions described below can then be called up one after the other. The unit is in diagnostic step 1 at the beginning.

Programme switch	SW4	Function
	ON	Diagnostic programme













Each time the "Start" key is pressed, the system switches to the next diagnostic step.

Maintenance and service

Checking the LED indicators

After switching on the unit, diagnostic step 1 begins: The LEDs light up one after the other.











		Limit value undercut
		Exceeding the limit value
		Analysis active
		Lack of reagent
		Device fault

Checking the buttons



After pressing the "Start" button for the first time, the buttons are tested.

By pressing the following buttons, the corresponding LED lights up:

		
		Valve" button
		
		Reagent" button
		

Maintenance and service

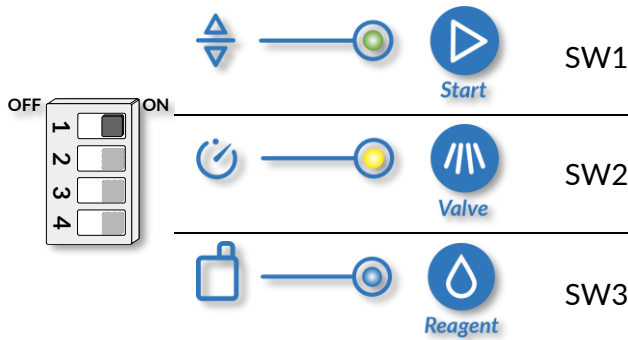


Reset" button

Checking the programme switches



After pressing the "Start" key for the 2nd time, the programme switches are checked. Switch the SW switches to ON and OFF again one after the other, each of the programme switches SW1 - SW3 is assigned a combination of LED displays. (SW4 is not checked as it is already ON for diagnosis).



Checking the rotary switch for the "flushing time



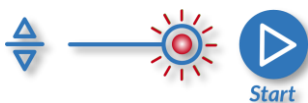
After pressing the "Start" button for the 3rd time, the "Rinse time" rotary switch is checked.

Turn the switch successively to the 16 positions from 0 to F. In each position, an LED combination corresponding to the HEX code is displayed.

		Rotary switch position															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Maintenance and service

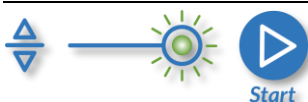
Check relay 1



After pressing the "Start" key for the 4th time, relay 1 is tested.

- The red LED flashes, relay 1 is switched on and off every second.
- Check the function of the relay at the connection cables with a continuity tester or a voltmeter, depending on the wiring.

Checking the relay 2



After the 5th actuation of the "Start" key, relay 2 is tested.

- The green LED flashes, relay 2 is switched on and off every second.
- Check the function of the relay at the connection cables with a continuity tester or a voltmeter, depending on the wiring.

Checking the solenoid valve



After pressing the "Start" key for the 6th time, the solenoid valve is tested.

- The yellow LED flashes and the valve is opened and closed every second.

Checking the actuator board LED



After the 7th actuation of the "Start" button, the white actuator LED is checked.

- The blue LED flashes and the measuring LED is switched on and off every second.

Checking the peristaltic pump



After pressing the "Start" key for the 8th time, the peristaltic pump is tested.

- The red LED flashes and the peristaltic pump is switched on and off every second.

Checking the agitator

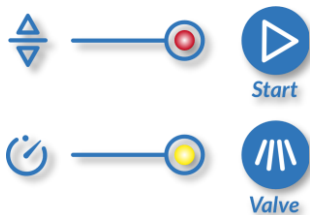


After pressing the "Start" key for the 9th time, the agitator is tested.

- The red and blue LEDs flash and the agitator is switched on.

Maintenance and service

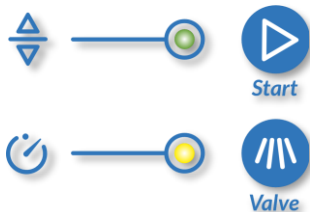
Check Start/Stop Input Contact



After the 10th actuation of the "Start" key, the input contact is tested.

- The black wires 1 and 2 of the input contact are bridged and opened. The input contact can be checked at the indicator LEDs.

Input contact open



Input contact bridged

Measure the zero value of the water sample



This test step is necessary to determine the zero value of the sample for the following colour detection test.



After pressing the "Start" key for the 11th time, the zero value of the optical path is measured with a colourless water sample.



- The last 3 LEDs flash.
- For testing the measuring section, the measuring chamber must be filled with clear water. Press and hold the "Valve" button until the solenoid valve opens, and the measuring chamber is flushed.

Colour recognition test



After pressing the "Start" key for the 12th time, the colour recognition of the optical path is checked.

- The last 3 LEDs light up.



The first LED signals whether the measured value is below or above the limit value.



- No display There is no coloured water sample available
- Green: Measured value below the limit value
- Red: Measured value above the limit value



Maintenance and service



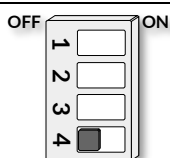
Reagent



Valve

- With the "Reagent" key, you can dose reagent into the measuring chamber to produce a colouration of the sample water
- Depending on the water hardness and the dosed reagent quantity, you will get a colour change, e.g., for total hardness from red to green.
- The turnover point is not a measure of water hardness because an undefined amount of reagent is dosed.
- The "Valve" button can be used to flush the reagent out of the measuring chamber.

Exit diagnostic program



After checking the unit functions, switch the programme switch SW4 back to the OFF position = analysis mode.



After the diagnostic programme has been carried out, switch all programme switches back to the original position or according to the local operating conditions.

Diagnostic functions LIMESBase

The LIMESBase does not have a diagnostic programme.

To unlock the diagnostic programme, you need an upgrade kit, which you can purchase from us.

For more information, see page 8, 21 and 68

Spare parts

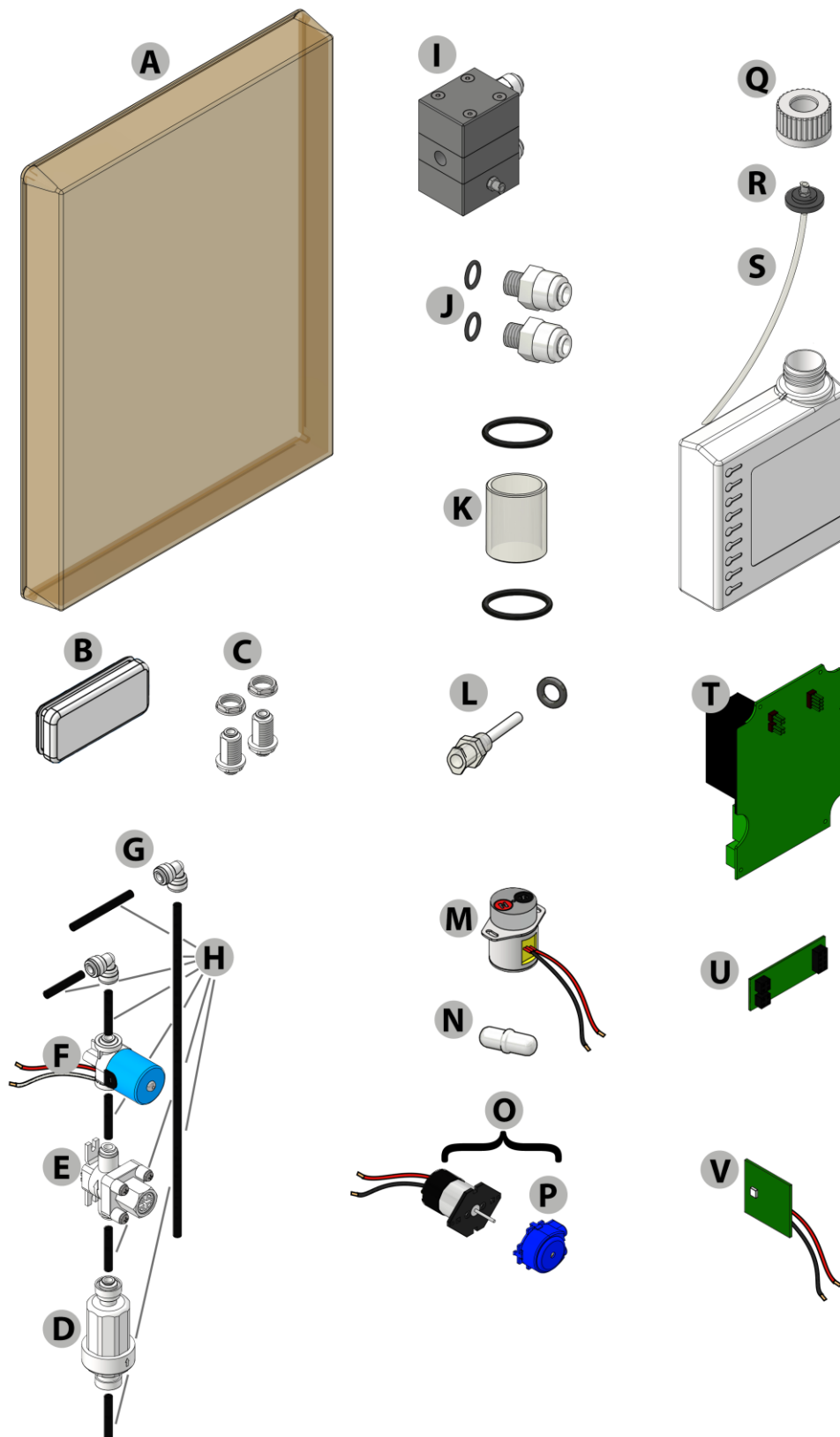


Illustration 22: Spare parts LIMES

Spare parts

Position	Article description	Article number
A	Housing cover Transparent LIMES	30-035 109
B	LIMESBase rubber cap	30-035 012
	LIMESPlus rubber cap	30-035 112
C	Bulkhead fitting white 1/4 inch (2x)	30-093 202
D	LIMES filter	30-093 218
E	Pressure regulator LIMES	30-093 079
F	Solenoid valve LIMES	30-035 004
G	Angle connection white 1/4 inch (1x)	30-093 216
H	Hose set 1/4 inch	30-035 201
I	Measuring chamber cpl. LIMES	30-035 104
J	Screw-in connection 1/4-inch LIMES incl. O-ring (2x)	30-055 203
K	Measuring chamber tube LIMES incl. O-rings	30-055 204
L	LIMES injector including O-ring	30-035 006
M	Stepper motor with magnet mount cpl. LIMES	30-035 108
N	Stirrer blade	33-090 002
O	Hose pump cassette incl. motor cpl. LIMES	30-035 106
P	Hose pump cassette cpl. LIMES	30-035 107
Q	Bottle cap, screw connection GL 32 grey	33-093 060
R	Bottle adapter	33-090 009
S	Suction lance cpl. LIMES	30-035 005
T	LIMES 110/230V Mainboard	30-072 004
U	LIMESBase plug-on board incl. mounting tool	30-035 202
	LIMESPlus plug-on board incl. mounting tool	30-035 203
V	Actuator board LIMES (LED)	30-090 182

Maintenance sets and accessories

Maintenance sets

The LIMES operates largely maintenance-free. A **maintenance set is available** for the analyser. It is recommended to install a maintenance set after 24 months.

(Hose pump cassette, hoses and O-rings are changed)

Furthermore, it is recommended to clean the measuring chamber regularly, at least every 6 months. The **LIMES Clean cleaning set** is offered for this purpose. It contains all the tools needed for cleaning as well as the cleaning fluid **FIT 3000**.

For information on how to perform maintenance, see from page 52.

Article description	Article number
Maintenance set for LIMES <i>Contains the following items:</i> <ul style="list-style-type: none">• 1 x LIMES tube measuring chamber• 2 x O-ring 24 x 2.5 NBR 70• 2 x O-ring 9 x 1.6• 1 x LIMES injector• 1 x O-ring 5.28 x 1.78• 1 x stirring blade• 1 x Hose pump cassette cpl. LIMES• 1 x suction lance cpl. LIMES	33-030 135
LIMES Clean cleaning set <i>Contains the following items:</i> <ul style="list-style-type: none">• 10 x Lab Gloves• 1 x funnel• 1 x Cleaner FIT 3000 (1000ml)• 1 x pipette brush• 1 x test tube brush wool head• 1 x container with lid	30-010 920
Cleaner FIT 3000 (1000 ml)	32-089 100

Maintenance sets and accessories

Accessories

Article description	Article number
LIMES junction box	30-035 200
Upgrade Kit from LIMESBase to LIMESPlus <i>Contains the following items:</i> <ul style="list-style-type: none">• LIMESPlus plug-on board• Circuit board extractor• LIMESPlus rubber cap	30-035 205
LIMES connection set <i>Contains the following items:</i> <ul style="list-style-type: none">• Reducing nipple Stainless steel 1.4408 V4A 1/2 inch to 1/4 inch (Conical external thread)• Socket ball valve stainless steel 1.4408 V4A with 1/4 inch (cylindrical internal thread)• Straight screw-in fitting, nickel-plated brass. 1/4 inch (cylindrical external thread with sealing ring), hose connection external diameter 1/4 inch.• 5 metre plastic hose outer diameter 1/4 inch	33-080 701
Stopcock 1/4-inch LIMES Connection size 1/4 inch	33-000 217



For more information on our products, please visit our website www.rls-wacon.de

Reagents

Reagents for monitoring total hardness

Designation Reagent	°dH	Limit value		Item no. 750 ml bottle	Item no. 4 x 750 ml bottles
		ppm CaCO ₃	°f		
LHV - 0.1	0,1	1,8	0,18	32-074 135	32-474 135
LHV - 0.5	0,5	9	0,9	32-074 165	32-474 165
LHV - 3	3,0	53	5,3	32-074 195	32-474 195
LHV - 7	7,0	125	12,5	32-074 210	32-474 210

One bottle of reagent is sufficient for approx. 10,000 limit value analyses.

Interesting facts about the reagents



The meter works with single-component reagents for different limit values. The reagents have a shelf life of 24 months if stored properly (dark and cool). 24 months.



Sample water with temperatures above 40 °C must be cooled before analysis.

Troubleshooting

After switching on, no LEDs light up on the unit

Cause	Measure
The mains voltage is not connected or not switched on.	Check the power supply / electrical connections. For junction box: Operate on-off switch.
The LIMESBase or LIMESPlus plug-on board behind the rubber cover is missing or incorrectly plugged in.	Check the plug-on board.
The fuse on the main board is defective.	Check the fuse.

The unit is leaking

Cause	Measure
An O-ring is missing from one of the connection plugs of the measuring chamber.	Check the O-rings of the plugs on the measuring chamber.
The water pressure is out of specification.	Check the water pressure and install a pressure reducer.

No analyses are started

Cause	Measure
The reagent has been used up or the reagent counter has not been reset after changing the bottle.	Check the level of the reagent bottle.
The input contact is in "flow monitor" mode and the input contacts are not bridged.	Check that the input contact is correctly configured and connected.

Error in the zero sample

Cause	Measure
There is no sample water in the measuring chamber	Check the water inlet
The reagent is not resolved.	Check whether there is an agitator blade in the measuring chamber.
No reagent is dosed.	Check the dosing pump in the diagnostic programme and the connectors in the unit.
The measuring chamber is dirty, or the sample water does not drain off	Clean the measuring chamber and check the water inlet and outlet.

Wrong measured value

Cause	Measure
The reagent is not resolved.	Check whether there is an agitator blade in the measuring chamber.
No or too little reagent is dosed.	Check the function of the peristaltic pump. Clean the motor shaft with spirit. Replace the peristaltic pump cassette. Check if the inlet is connected on the left side.
An incorrect reagent has been inserted or the reagent has expired.	Insert a new reagent bottle and reset the level counter.
Water is constantly running through the drain.	Remove foreign objects from the solenoid valve so that it closes properly.
No water runs through the drain.	Check solenoid valve and upstream shut-off devices.
The sample water contains high concentrations of iron or other chemicals that interfere with the measurement.	Examine the water of the unit for compliance with the unit specification.

Appendix

Maintenance and service

Model:


Serial number:

Date	Employees	Comment

Appendix

Settings

Position - Programme switch					
SW1	Analysis interval	Off <input type="checkbox"/>	Off <input type="checkbox"/>	On <input type="checkbox"/>	On <input type="checkbox"/>
SW2		Off 5 min	On 10 min	Off 20 min	On 30 min
SW3	Input contact	<input type="checkbox"/> Off <input type="checkbox"/> On			
SW4	Diagnostic mode	<input type="checkbox"/> Off <input type="checkbox"/> On			

Position - Rotary switch (flushing time)																
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	5 Sec	10 Sec	20 Sec	50 Sec	90 Sec	2 Min	4 Min	8 Min	10 Min	12 Min	14 Min	16 Min	18 Min	20 Min	25 Min	30 Min
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Designation Reagent	Limit value		
	°dH	ppm CaCO ₃	°f
<input type="checkbox"/> LHV - 0.1	0,1	1,8	0,18
<input type="checkbox"/> LHV - 0.5	0,5	9	0,9
<input type="checkbox"/> LHV - 3	3,0	53	5,3
<input type="checkbox"/> LHV - 7	7,0	125	12,5

Document changes

Date:	Change:
22.08.2022	Publication of the document
21.09.2022	Improvement

Safety reliably produced.



EG-KONFORMITÄTSERKLÄRUNG


EC-Declaration of Conformity

Hersteller <i>Manufacturer</i>	RLS Wacon analytics GmbH	
Anschrift <i>Address</i>	Gropiusstr. 12 D-31137 Hildesheim	
Produktbezeichnung <i>Product specification</i>	LIMESBase / LIMESPlus	
Wir erklären in alleiniger Verantwortung, dass das oben bezeichnete Produkt mit folgenden Europäischen Richtlinien übereinstimmt: <i>We declare that the above product is in conformity with the following directives:</i>	2014/35/EU	Niederspannungsrichtlinie <i>Low Voltage Directive</i>
Angewandte harmonisierte Normen und technische Spezifikationen: <i>Applied harmonised standards and technical specifications:</i>	DIN EN 6100-3-2 DIN EN 6100-3-3 DIN EN 61326-1	
Qualitätssicherung der Produktion angelehnt an: Production Quality Assessment according to:	DIN EN ISO 9001:2015	

Hildesheim, 15. 08. 22

Ort, Datum der Ausstellung
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Dr. Sascha Matern


Name und Unterschrift des Befugten /
Dokumentenbevollmächtigter
Name and signature of authorized person /
Document manager

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Photo back: Vitali Vidnevski (employee RLS Wacon analytics GmbH), 2015
Changes and errors excepted



The RLS Wacon analytics GmbH is a family-owned enterprise based in Hildesheim, Germany. For more than 40 years, we are developing and manufacturing robust and safe measurement and sensor technology for demanding applications. We hereby consistently focus on quality and well-known products. Our particular interest is the dialogue with customers, partners and suppliers. That's how *safety is reliably produced.*

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